AUG 18 1910

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXV NO. 7 | SAN FRANCISCO, AUGUST 13, 1910 | PER COPY, 10 CENTS

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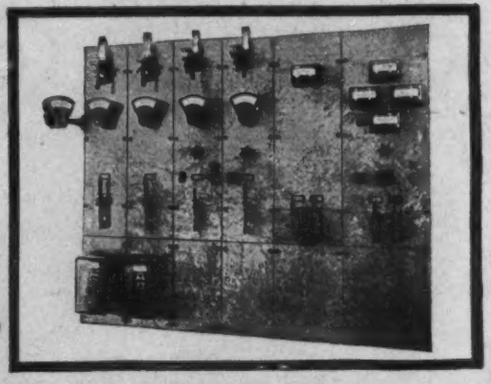

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXV SAN FRANCISCO, AUGUST 13, 1910. NUMBER 7

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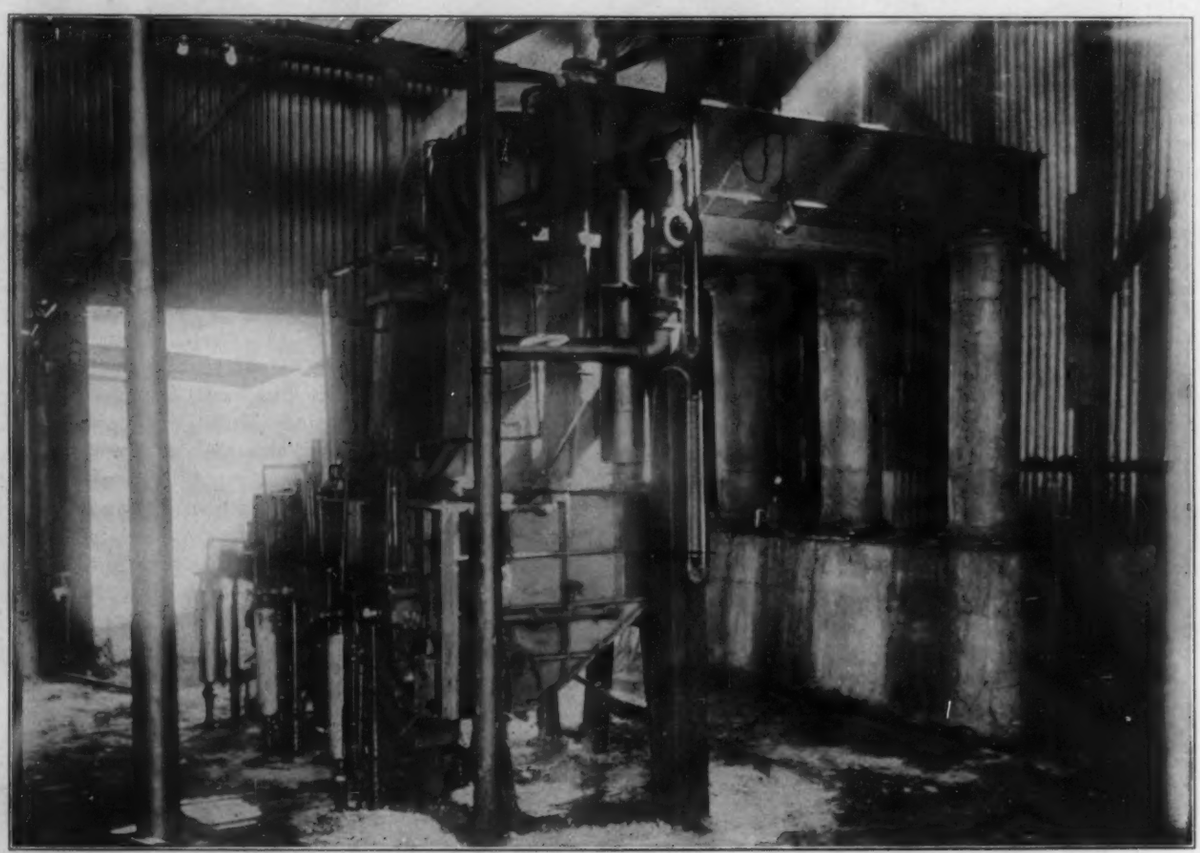
THE INTERNAL COMBUSTION ENGINE VERSUS THE STEAM ENGINE ON THE PACIFIC COAST

BY WM. VAN DEN HEUVEL.

The internal combustion engine as a prime mover in power plant work on the Pacific Coast and adjoining territory is yet in its infancy compared with the development of this form of motive power in the East and in Europe. Analyzing the local situation we find a wide-spread prejudice that retards the installation of gas engine plants and favors the use of steam, even with its lower economy. As many put it, "The good, old reliable steam engine is good enough for me; we need power 24 hours per day and we cannot afford to have any shut-downs."

It is the object of this article to roughly review the different kinds of fuel used with internal combustion engines and to analyze such features as become evident in a comparison with a steam plant of from 100 to 500 h.p. capacity. Most purchasers and a good many of the dealers in gas engines do not realize that with each gas engine installation there should be a thorough, complete, advance consideration of the load and conditions under which the gas engine is to operate. Though the number of adjustments left in the hands of the operator are few, they are, nevertheless, all the more important.



Amet-Ensign Oil-Gas Producer Installation at Yuma, Ariz.

The writer has seen gas engines operating poorly

because of faulty timing of the ignition and of the valves; the governor was working only as an objectionable ornament; the cooling water in the jackets had no relation whatever to the average load carried, or even to full load. Engines which were sparking past the center had marks on the lay-shaft made by the factory, but creep and wear had made them obsolete. Such marks should be on the fly-wheel and the frame. Little has been said or done regarding the use that can be made of the 75 per cent of the total energy in the fuel fed to the engine that is lost in the cooling water for the jackets and in the exhaust gases. The popular opinion is, that, in most cases, arrangements to save this energy are only objectionable refinements yet in the experimental stage.

The amount of cooling water establishes the temperature of the cylinder walls and the form and efficiency of the explosion. It also affects the lubricating properties of the cylinder oil. As a result, cylinders and valves may foul quickly or again remain clean for a long period. A thermostat-valve in the water supply to the jackets would regulate the cooling water under variations in load and in the initial temperature of the cooling water. I am merely touching upon these points to emphasize the fact that gas engines, even while operating, require intelligent adjustment to give satisfactory operation and fuel-economy.

In a steam plant the power absorbed by the auxiliaries varies from 7 to as high as 30 per cent, depending upon the arrangement of the plant and the skill with which it is operated. Careful firing may decrease the fuel bill as much as 20 per cent, and yet, even with the most wasteful firing, and the number of steamplants with smokestacks coming under the classification of public nuisance is large, the continuous operation of the plant is not interrupted.

We may say that the gas engine plant, in its operation, is a check on itself and the operators. When the plant shows no or few interruptions of service, the owner may be reasonably sure that his plant is also being operated with the least amount of fuel necessary. No such conclusion can be drawn with the steam plant.

Far be it from the writer's intention to depreciate the operation and management of our good steam plants, particularly the large ones, but he wishes to emphasize that steam plant methods do not fit the gas engine plant, that one cannot get the benefits of the inherent low fuel consumption and continuous operation without necessary care and adjustments, also that with these adjustments once made in the properly installed gas engine plant continuous power is just as much of a possibility as in the steam plant.

It will be of interest to consider at some length some of the construction details of the gas engine plant. One of the most important advantages of the gas engine plant over the steam plant is the absence of large stand-by losses, in other words, the gas engine plant may be started and stopped at will, without incurring a loss incident to bringing up steam and to the stored and wasted energy in the boilers. Starting of the gas engine is usually affected by compressed air admitted to one or more of the main engine cylinders; air is furnished by an air-compressor outfit driven by a separate engine or motor. This compressor and the storage tanks should be of liberal size. Manufacturers tend to economize on this feature, saving perhaps $150, while the losses in time and fuel counted over the entire year mean a loss several times this amount.

Direct connection of the gas engine is often condemned, the argument being that the shock due to the explosion calls for flexible parts to take it up and it is held that the more flexible steam drive admits more readily of direct connection.

While this contention is correct in principle, the writer wishes to state that there are many instances in which it is carried too far; the problem of the selection of a suitable drive, comparing gas and steam engines, becomes entirely one of the design of the engine, especially of the flywheel. Many installations consisting of a belted engine could have been made direct connected by arranging from the outstart for heavier fly-wheels and a flexible coupling between the engine-shaft and the apparatus to be driven.

Particularly in pumping plants the prejudice against the direct connected gas engine has been carried too far. It is not necessary to use special engines to obtain the flywheel effect desired, as manufacturers can arrange this when duly informed as to the nature of the load to be carried. The difficulties of a large belt-drive together with its maintenance, cost and increased floor space make a consideration of each individual case well worth while.

The regulation of an engine, whether steam or gas engine, must satisfy two requirements. The first, the so called rotative regulation, is an expression giving the fluctuation of angular velocity during a full revolution. The better the rotative regulation the more uniform is the velocity of a point at the circumference of the fly-wheel under constant load. The weight of the fly-wheel, in conjunction with its dimensions and the number of revolutions at which it is operated, serves the purpose of counteracting the impulse due to steam admission or explosion of the mixture. The flywheel absorbs or gives up the energy due to the reciprocating motion of the piston, connecting rod and cross head, at the moment of reversal of the stroke. Changes of load instantaneous in nature, are also neutralized to a certain extent; however, here the governor begins to play its part. The more sensitive the governor, the more readily will it respond to changes of load, maintaining a uniform speed under variations of load within the so-called speed regulation of the engine. In comparisons of the regulation of steam and gas engines we must deal entirely with the rotative regulation, and we find that the designer of the gas engine must provide heavier and larger fly-wheels to obtain the same regulation as in the steam engine.

High rotative regulation is not always necessary; electric service has made high demands, however, in order to eliminate voltage fluctuations and also to prevent cross-currents in synchronizing generators and to overcome hunting as a result thereof. Any good gas engine manufacturer is now in a position to make guarantees on speed or rotative regulation, entirely meeting the requirements of electric service under the severest conditions.

The gasoline engine and the distillate engine are

essentially a compromise for the use of crude oil direct in the cylinders. Even though in many cases the reason for the use of these engines may be well founded, it still remains true that the direct use of the raw material, under elimination of cost for either partial or total refining, will always be considered the most desirable.

The economical production of power on a large scale, say above 100 h.p. occurs in the oil engine by burning the oil direct in the cylinders or in the producer gas engine, utilizing a gas made from crude oil in special apparatus provided for that purpose.

There are two practical oil engines now on the market, the Diesel engine, manufactured under a foreign license by Adolphus Busch of Saint Louis, Mo., and the oil engine of the De La Vergne Machine Co. of New York City. To my knowledge both manufacturers build engines in sizes not to exceed 300 h.p. and their engines have met with good success in the Eastern States. So far, neither firm has installed engines on the Pacific Coast. The writer has received proposals from of these firms, expressing their willingness to make guarantees on performances with California crude oil. Little can be said in an article of this kind, dealing with established facts only, what the future of these engines will be on our coast. The engines are constructed in a first-class manner by highly reputed builders who will undoubtedly exhaust all means to overcome the difficulties incident to the direct use of California asphaltum base oil in the engine cylinders.

Natural gas, usually of a heating value of about 900-1000 B.t.u. per cu. ft., is found in a number of localities throughout California, and is particularly suited for use in gas engines. Invariably, the development of the natural gas flows is restricted by the risk that the flow may stop or diminish and thus make the engine-installation useless. The measure of risk assumed in making a natural gas installation would be reduced by the installation of oil-gas producers at the outstart or whenever the yield of the gas wells would make desirable an additional gas supply. Natural gas and producer gas may be mixed in any proportion and this would occur by diffusion in the gas holder which would be a part of the installation. The gas engine can be made to fit either gas by a change of the compression carried.

An engine that is to work on both natural and producer gas should be designed to meet the requirements of the producer gas. Thus all dimensions, including the weight of the fly-wheel, would be ample or rather too large for operation on natural gas. The compression can easily be changed by the introduction of shimming pieces in the connecting rod, thus moving backward the piston and reducing the compression space.

The gas-engine operating on illuminating gas works less efficiently than any other gas-engine of the same type and size. The large percentage of hydrogen contained in the gas causes premature combustion at the compression that corresponds to the explosive pressure for the best result in economy. A large part of the cost of illuminating gas is due to the process of cleaning and washing to which it is put for lighting purposes and we may say that the gas engine will operate as well with a gas less clean.

The only gas engine installation of magnitude, operated on oil-gas was the Martin plant of the Pacific Gas & Electric Co., San Francisco. The gas used was practically an illuminating gas and the percentage of hydrogen by volume contained in the gas made at various times varied from 60 per cent to about 40 per cent. All the reports on the operation of this plant seem to indicate that premature combustion has been one of the serious obstacles. The cause for this may have been in the presence of too large an amount of hydrogen, though it has also been found that larger percentages of hydrogen may be used satisfactorily, provided that the compression chamber is constructed without sharp corners, that the valve-ports are properly rounded and that the ignition devices are placed at the proper point in the combustion-chamber. Even with the scant knowledge available of the construction details of this plant, the writer considers unfair a comparison of it with the large steam turbine plant, in a manner as presented by Mr. A. M. Hunt in an article read before the American Institute of Electrical Engineers at San Francisco. If it were possible, through presence of data on large oil producer and gas engine plants, to make a comparison at this present date, we might safely say that only such oil-gas installations will offer serious competition for the steam-turbine plant as require no more attention for the producers than a first-class boiler plant, preferably less, The holder should be only large enough to operate the plant at full load for, say no longer than 10 minutes. This would call for a producer fit to operate continuously. To properly compete an oil-gas installation should manufacture a gas that would be fit for use in the engines without danger of premature explosion or that would not be so variable in its properties as to make it impossible for the governor of the engines to follow up the fluctuations and give good regulation.

Producer gas manufactured from crude oil has been the nightmare and aim of many inventors; lack of knowledge of the chemical phenomena or of design of the producer and washing apparatus or again failure to grasp the physical and mechanical requirements that go to make a successful, commercial plant have been the obstacles in most cases. Oil-gas has been made in Germany, Russia and America for a number of years. We find mostly the so called retort process used whereby the crude oil is heated in a closed vessel and thus broken down into the constituents of the gas. Most processes are a combination of this retort process and of the water-gas process, the latter being the familiar reduction process of manufacturing carbon monoxide gas from carbonic acid gas by leading the latter over incandescent carbon. All these processes are intermittent in their nature; the gas-maker manipulates constantly and at regular intervals the various valves for oil, air and steam, alternating thereby a series of gas-makes and blasts. The latter are necessary to re-establish the temperatures necessary to conduct the process, also, to prevent injurious accumulations in the path of the gases as well as in the retort of lamp-black and tar that might interfere with the continuous operation of the producer.

In order to eliminate the constant manipulation of valves and constant attention of the operator, other producers have been devised. To the writer's knowledge, only two of these types of producers have been in actual operation, namely the Amet-Ensign and the Nix-Frost producers.

To go into the detail construction and operation of producers is not the object of this article. The writer, however, has had considerable personal experience with the Amet-Ensign producer in several places, particularly the government installation at Yuma, Ariz., where he made tests for the purpose of acceptance of the plant. With this process a fixed gas is made of an approximate heating value of 200 B.t.u. per cu. ft. On the basis of an economy of the engine equivalent to a consumption of 10,000 B.t.u. per brake h.p. per hour. This means an hourly consumption of 50 cu. ft. of gas per brake h.p.

The economies obtained in plants using oil-gas is high, averaging about 7 brake h.p. per gallon of oil per hour. While in some cases it has been demonstrated that this figure may be exceeded, it may be considered to represent the present state of the art. Economy in the oil-gas producer plant is not as much dependent upon the size of the plant as is the case with steam-plants, the economy mentioned above being realized in all plants above and including 100 h.p.

Steam-plants in actual operation do well when producing 3.5 brake h.p. per gallon of oil per hour fired under the boilers. Test reports published by the U. S. Geological Survey during the last few years show such figures and owners of steam-plants below 300 h.p., as well as of a good many of a larger capacity, know from their own records that they cannot do any better in operation from month to month. Continuing the comparison of the steam and the gas engine plants, experience has shown that a producer plant does not require any more attention than a boiler plant, even less, but if we assume that the number of operators is the same, then the comparison results in a balance of the higher first cost of the gas engine plant on the one side against the larger fuel consumption of the steam-plant on the other. Allowing for the different types of plants, varying with the work that the plant is to perform, the statement may be made that the cost of the gas engine plant may be as much as double that of the steam plant before it will offset the saving in fuel made each year in the gas engine plant.

To illustrate this statement, we may take a 300 h.p. plant operating at 60 per cent load-factor, 24 hours per day during the entire year. The total power produced will be 157,000 h.p. hours or the yearly fuel consumption 10,700 bbl., assuming an economy of 3.5 brake h.p. per gallon. The gas-engine plant with an economy of 7 brake h.p. per gallon will consume half this amount or 5350 bbl., costing, putting the price very low, $2675. Against this saving we must balance the larger cost of the gas engine plant. Assuming that the investor pays 7 per cent for his money and that he writes off on the books for depreciation of the plant each year 7 per cent of the total cost, then 14 per cent must represent $2675 or in other words the surplus cost of the gas engine plant must be $18,000. Again, supposing for the sake of simplicity of comparison, that the first cost of the steam plant installed amounts to $18,000, which would be $60 per h.p., a rather low figure, then the cost of the gas engine plant would have to be $36,000 in order to obtain the same yearly operating expense for the two types of plants. The average gas engine plant does not, by any means, cost twice as much as the average steam plant; the excess cost generally amounts to about 30 per cent and it becomes evident that big savings may be affected.

The lost energy of the gas engine becomes available in two forms and amounts to approximately 75 per cent of the energy in the fuel consumed. The energy lost through the jacket-water is available at a temperature of about 160 degrees F., that through the exhaust gases at about 600-1000 degrees F. The number of uses to which this energy may be put is large, much larger than with the steam plant which gives up its lost energy through the exhaust steam at the temperature of steam at nearly atmospheric pressure or about 220-230 degrees F. When utilizing the lost energy in the steam plant, the economy of the engine, run non-condensing, is very low and when attempting to better this economy by condensing, the lost energy is presented to us in the cooling water at the still lower temperature of about 110 degrees F. Generally, it is desirable to use the lost energy at as high a temperature as possible and therefor the gas engine offers a larger field of application.

A large number of auxiliaries for gas engine plants have been placed on the market, but here, even more than with the steam-plant, one should be careful in the selection of apparatus best suited for the application of the waste heat, in particular with a view on the probable load on the plant from day to day.

The introduction of the internal combustion engine into plants for office buildings will be possible only with careful considerations of the above nature. The same must be said of plants for laundries and for various factories where hot water or the heating of substances in driers ,hot-rooms or otherwise forms an important item. In plants where the requirements for heating exceed the amount of heat available from the lost energy in the gas engine, the old auxiliary heater with an oil-burner constitutes a simple and effective means to supply the lacking heat independent from the performance or load of the main engine. This is an important economical feature, for do we seldom see installations using exhaust steam from engines where the load is occasionally insufficient to provide the required amount of steam for steam heating and where live steam is introduced by means of a reduction valve from the main steam line and thus converted into steam of low pressure with accompanying unnecessary large losses.

California, with its large oil deposits, and under the present activity in oil-production and transportation, is facing a problem in the economical transport of the oil. The present method using large direct-acting steam pumps is indeed one whereby economy is not given much consideration. The gas producer and the gas engine will offer an opportunity for some true conservation work in the oil fields, going hand in hand with the practical application of the lost energy of the gas engine to the heating of the oil to a degree desirable

for minimum friction in the pipe-lines versus loss in valuable volatiles caused by excessive heating.

In all considerations presented in this article the reciprocating steam-engine has been referred to, not the steam-turbine simply because on this coast the steam-turbine has asserted itself more particularly in the larger plants, because of the high economies realized in such and not obtainable in the smaller units, also on account of the simplicity of operation and compactness of plant lay-out. It cannot be stated at the present date, in how far the large gas-engine plant will rival the large steam-turbine plant; so far, no gas-engine plant has been installed, embodying all the high attainments of the gas-producer and gas-engine professions.

UTILIZING WASTE HEAT FROM GAS ENGINE PLANTS.[1]

BY JOHN T. FAIG.

Two sources of great heat waste occur in internal combustion engines, the jacket water and the exhaust. This waste is so common that there is danger of losing sight of its importance. The amount of heat so lost varies in different engines, but is nearly always three times as great as the amount converted into work in the cylinder.

Not only is the heat of the jacket water lost in most cases, but its removal entails considerable expense; that is, the cost of the jacket water itself. There are, it is true, some few installations where the jacket water is used for heating or industrial purposes, but these are merely exceptions to the general run of plants.

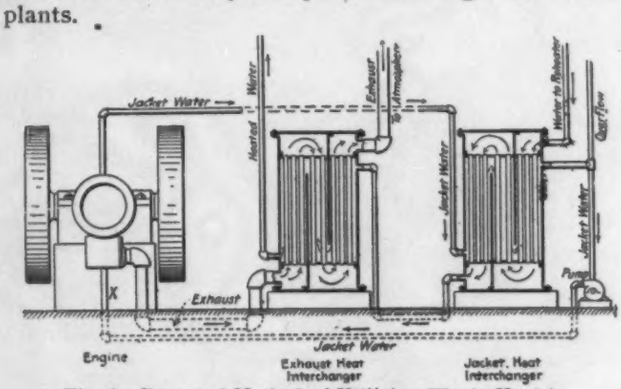


Fig. 1. Proposed Method of Utilizing Waste Heat in Jacket Water and Exhaust from Gas Engines.

The development of auxiliaries that will utilize the heat of the jacket water and exhaust gases must keep pace with the development of internal combustion engines if these engines are to compete with steam engines where the exhaust is used. Where hot water for heating or industrial purposes is required the utilization of most of this waste heat presents no great difficulty. Fig. 1 represents an engines with two simple heat interchanges, one using the jacket water and the other the exhaust gases. The jacket water is used over and over. The water to be heated must have sufficient pressure to overcome friction of passage through the interchangers.

The same idea may be expressed in many different designs. There is no reason why one interchanger should not be placed on top of the other, or the two combined in the same shell. One form of interchanger has recently been put upon the market.

Some firms use part of the heat of the exhaust for vaporization of water for the producer. The writer has given some attention to the utilization of waste heat from producer power plants and has designed a plant utilizing practically all of the heat in the coal, except the inevitable losses of hot ash, mechanical friction and radiation, all of which may be reduced to very small percentages of the total.

The interchanges may be of the simplest construction, since all pressures are small and temperatures comparatively low, the highest being that of the exhaust gases, from 600° to 1,000°. A thermostatic valve could be installed to automatically admit cold water from the city mains should the temperature rise too high. This might occur if for any reason the circulation of the water being heated should be stopped. The exhaust gas interchanger should form an excellent muffler. The exhaust pipe between the engine and interchanger should be covered to reduce heat loss to maintain a reasonable temperature near the engine and to prevent burnt hands.

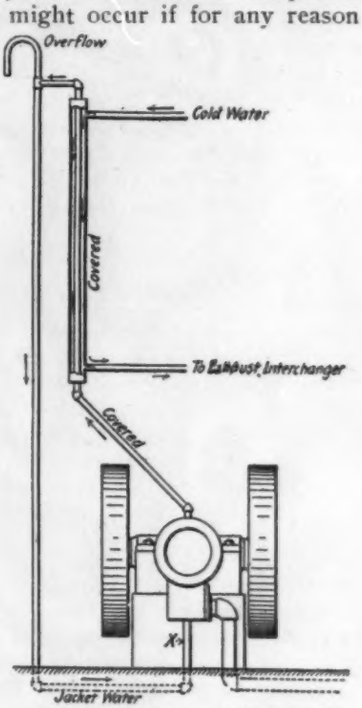


Fig. 2. Alternative Method of Utilizing Waste Heat in Jacket Water from Gas Engines.

Fig. 2 shows an interchanger using the jacket water of an internal combustion engine to heat water. The jacket water is used over and over. The heated water passes to an exhaust interchanger, similar to that in Fig. 1, to be further heated. This arrangement does away with the necessity for a circulating pump in the jacket water line. A thermostat controls the admission of cold water to the jacket water line and will operate if for any reason the interchanger does not absorb sufficient heat from the jacket water. The jacket water interchanger may be secured against a wall overhead to save space if there is sufficient head room. The height which will give the proper circulation for a given engine could probably be determined only by trial.

[1] Extract from paper read at a July, 1910, meeting of the National Gas and Gasoline Trades Association.

CALCULATION OF GAS ANALYSIS.

BY R. F. CHEVALIER.

Having already described the combination of oxygen with the various elements in the oil, and the combining weights of each, the application of the results obtainable from the flue gas analysis will now be illustrated.

For complete combustion, a pound of carbon requires 2.67 pounds of oxygen, equal to a volume of 32 feet at 60 degrees F. When the products of the combination (carbon dioxide) cool, they occupy the same volume as the oxygen did originally. Oxygen is mixed with the nitrogen in the air in the proportion of 20.91 to 79.09. After complete combustion, the volume of carbon dioxide will be in the same proportion to the nitrogen as that of the oxygen originally. Therefore with complete combustion of carbon with no excess of air, the volumetric analysis of the gases is

Carbon dioxide	CO_2 = 20.91%
Carbon monoxide	CO = 0.0 %
Oxygen	O = 0.0 %
Nitrogen	N = 79.09%

When air is in excess of the amount required to supply the oxygen needed, the sum of the volumes of carbon dioxide and oxygen is the same as that of the oxygen before combustion.

In a fuel containing hydrogen, the percentage of nitrogen in the flue gases is apparently increased. This is due to the fact that the nitrogen accompanying the oxygen required for combustion with the hydrogen remains in a gaseous form while the products of the combination of hydrogen and oxygen (H_2O or steam) condense at the temperature that the analysis is made Oil fuel contains from 11 per cent to 13 per cent of hydrogen. Therefore the percentage in volume of nitrogen would be increased, and that of carbon dioxide would be correspondingly decreased in the composition of the flue gases of this fuel.

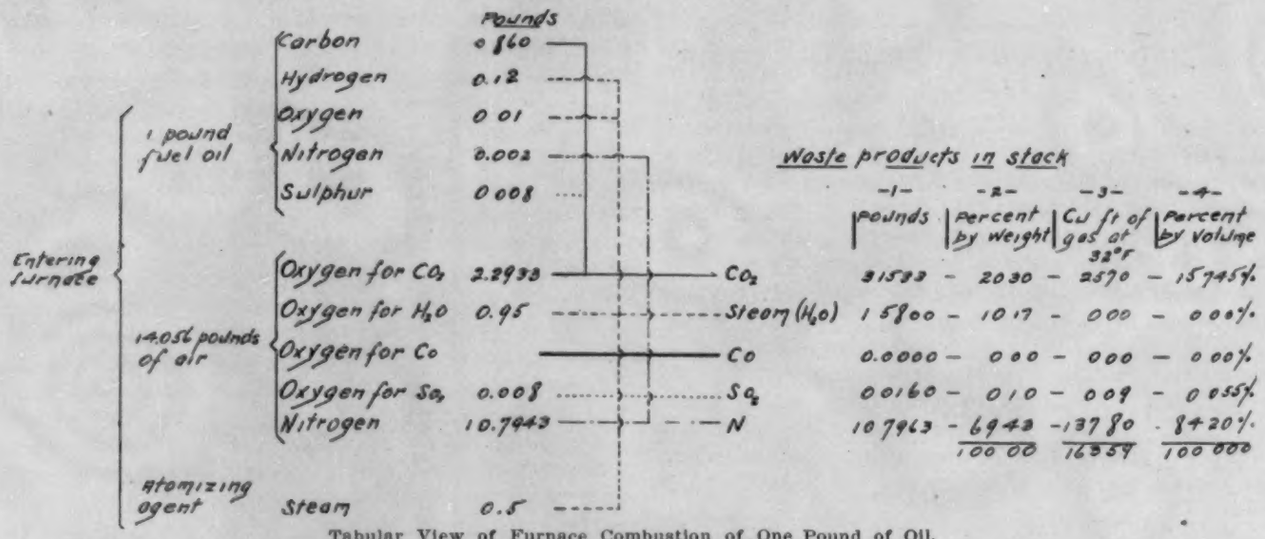
On referring to the "Tabular view of furnace combustion of one pound of oil," the results in the last column show that the maximum amount of carbon dioxide by volume found in waste gases from the average oil fuel is 15.75 per cent.

Column 3 is calculated by dividing column 1 by the weight of one cubic foot of gas. The density and weights of gases at atmospheric pressure will be found in table No. 6.

To determine the ratio of air supplied per pound of oil to the amount theoretically required, use is made of the following formula,

$$\frac{N}{N - 3.782\ O}$$

which is derived as follows:



Tabular View of Furnace Combustion of One Pound of Oil.

The nitrogen in the flue gas is the total amount that entered the furnace with the oxygen of the air. The oxygen was supplied with the air, but was not used. Nitrogen accompanied the oxygen by 3.782 times the volume of the latter. If $N - 3.782\ O$ represents the nitrogen entering with the air actually required for combustion, then

$$\frac{N}{N - 3.782\ O} = \text{the ratio of the}$$

air supplied to that actually required. Subtracting 1.0 gives the excess air in per cent.

Heat loss in flue gases is equal to the weight of the gas per pound of combustible, times the specific heat of the gases, times the difference of temperature of the escaping gases and that of the air entering the furnace, the formula of which is as follows:

$$L = 0.24\ W\ (T - t)$$

where

L = B. t. u. lost per pound of fuel.
W = Weight of flue gases in lbs. per pound of fuel.
T = Temperature of flue gases.
t = Temperature of atmosphere.
0.24 is the specific heat of the flue gases.

Where an analysis by weight is required, it can be found from the volumetric analysis, by multiplying the percentages by volume by the molecular weight of the

gas and dividing by the sum of all the products. The quotient will then be the percentage by weight.

We will assume that an average of the analysis of gases from a furnace show carbon dioxide 12.6 per cent; oxygen 4.2 per cent; and no carbon monoxide. The nitrogen, the other constituent of the gas is found by difference, i. e.:

$$100 - (12.6 + 4.2) = 83.2\%$$

The completed results will then read:

CO_2 — 12.6%
O — 4.2%
CO — 0.0%
N — 83.2%

Total.... 100.0%

The ratio of air supplied to that required would be

$$\frac{N}{N - 3.782\ O}$$

substituting

$$\frac{83.2}{83.2 - (3.782 \times 4.2)} =$$

$$\frac{83.2}{67.7} = 1.228 = \text{ratio of air supply.}$$

1.228 — 1. = .228 or 22.8% excess air.

In table No. 7 is shown the method of converting an analysis of flue gases by volume into per cent by weight.

TABLE NO. 6.

DENSITY OF GASES AT ATMOSPHERIC PRESSURE.

Gas	Symbol	Specific Gravity Air = 1	Weight of one Cubic Foot at 32° F. Pounds	Cubic Feet per pound at 32° F.	Relative Density Hydrogen = 1	
					Exact Relative Densities	Approximately
Oxygen	O	1.10521	0.088843	11.257	15.96	16
Nitrogen	N	0.9701	0.078314	12.764	14.01	14
Hydrogen	H	0.069234	0.005589	178.930	1.00	1
Carbon dioxide	CO_2	1.51968	0.122681	8.158	21.95	22
Carbon monoxide	CO	0.96709	0.078071	12.818	13.97	14
Methane	CH_4	0.55297	0.044640	22.412	7.99	8
Acetylene	C_2H_2	0.898.20	0.073010	13.697	12.97	13
Aceylene	C^2H_2	0.89820	0.073010	13.697	12.97	13
Sulphur dioxide	SO_2	2.21295	0.178646	5.598	31.96	32
Air		1.0000	0.080728	12.383	.....	..

Adapted from Kent

TABLE NO. 7.

Gas	Analysis by Volume	Molecular Weight	Volume x Molecular Weight	Analysis by Weight
Carbon dioxide	12.6 %	12 + (2 x16)	554.5	$\frac{554.5}{3016.9}$ = 18.4%
Carbon monoxide	0.00%	12 + 16	0.0	$\frac{00}{3016.9}$ = 0.0%
Oxyegn	4.4 %	32	134.4	$\frac{134.4}{3016.9}$ = 4.4%
Nitrogen	83.2%	28	2328.0	$\frac{2328.0}{3016.9}$ = 77.2%
		Total....	3016.9	100.0%

JACKETING STEAM CYLINDERS.[1]

R. F. Chevalier: At the last meeting we had a discussion on high and low receiver pressure, and steam jacketing, but we were unable to come to any conclusions.

A. W. McDonald: As regards the subject of high and low receiver pressure let us determine which is the best.

H. D. Saville: For this purpose let us assume that the majority do not know anything about this subject and proceeding upon this assumption we will ask Lawrence to tell us what he knows about it. He will tell us about steam-jacketing and what its purpose is.

J. M. Lawrence: The object of steam-jacketing is to keep the steam in the cylinder, all that can be kept there, so that it does not lose its heat to the atmosphere.

John Traynor: Jacketing superheats the steam and gives better economic results. It is said that vacuum gets better results. I have not tried it; though I am convinced that the vacuum would be the proper thing. The engine might not show quite the energy that it would with superheating the steam in the jacket, but would give very much better results when one takes into account the efficiency of the plant as a whole because of less fuel being used. I contend and can prove that the steam-jacket on a cylinder as ordinarily used is absolutely worthless. The idea is that it increases the efficiency of the plant as a whole, with certain exceptions. Our object nine times out of ten is to produce and give power with less fuel. When a jacket is put on you do not do this.

R. F. Chevalier: The object of steam-jacketing is this: Supposing that steam enters the cylinder at a pressure of 20 lb. absolute which would be 5 lb. by gauge, and that the terminal pressure is 2 lb., equivalent to a vacuum of 26 inches. The temperature of the steam entering is 228 degrees F. When expanded to 2 lb. the temperature is 126 degrees F., causing a drop of 102 degrees. This has a tendency to cool the cylinder, and when steam is again admitted, some of the heat units are used to again raise the temperature of the cylinder, thus absorbing some of the energy that would have otherwise done useful work. Steam-jacketing is supposed to offset this loss.

H. D. Suville: As regards the number of foot-pounds of duty per thousand pounds of steam. In a pumping plant for example, the final result is not so much foot pounds of duty per given amount of steam, but rather the actual duty of putting a certain amount of water into the reservoir. Steam-jacketing is like this: if the combined heat units used in the cylinder in doing the work, and in the jacket, are measured, and the cost of producing this heat is known, that will represent the efficiency of the plant as a whole and this is the point in which we are interested. We are interested in the units generated in kilowatt hours but the thing in which we are particularly interested is the putting of the kilowatts on the board. In stating the question of steam-jacketing or economy of the plant as a whole everything is taken into consideration, inclusive of the benefit derived from the steam-jacket alone, and if there is not a saving it may not be worth the while. The best way to determine the value of steam-jacketing is to make tests with and without the jacket, all other conditions being kept the same.

C. E. Van Meter: I put up a compound condensing engine guaranteed to produce a horsepower on 13 pounds of steam. I jacketed both the high and low pressure cylinders, everything being jacketed to make it as efficient as possible. After it had run smoothly for some time one of the jackets sprung a leak and both jackets had to be cut out. In installing this plant everything was up-to-date; meters on the feed and oil pipes; reports filled out each shift by the engineers; the oil used, and the gravity, the number of gallons of water fed the boilers and the load on the engines being regularly read. When the

[1]Discussion at meeting of California No. 3, N. A. S. E., July 13, 1910.

jackets were cut out on account of the leak there were reports every twenty-four hours to show the difference in the consumption of fuel and oil. Cards were taken from the engines before and after the jackets were taken out. It was thus found that the consumption of fuel was just the same with jackets on or off, but the efficiency of the engine and the horsepower delivered per pound of steam were different and so I came to the conclusion that it was merely a scheme to boom the engines but that it does not affect the owner's pocket-book a bit.

W. H. Munro: My plant had 40 feet between cylinders and the jackets were a great help. The load was changed all the time. You could hold your hand on the low pressure cylinder. If you cut the jackets out the fireman knew the difference right away. However, this is an unusual case.

G. E. Van Meter: My engine is a high pressure one only. The steam enters the jacket at about 4 degrees F. above what the temperature due to the pressure would be but the steam was re-heated. The steam-jacket here would be a waste because of the re-heating.

R. F. Chevalier: Steam-jacketing supposedly overcomes condensation; therefore a loss of heat in the cylinders; thereby obtaining more work with a given quantity of steam entering the cylinder.

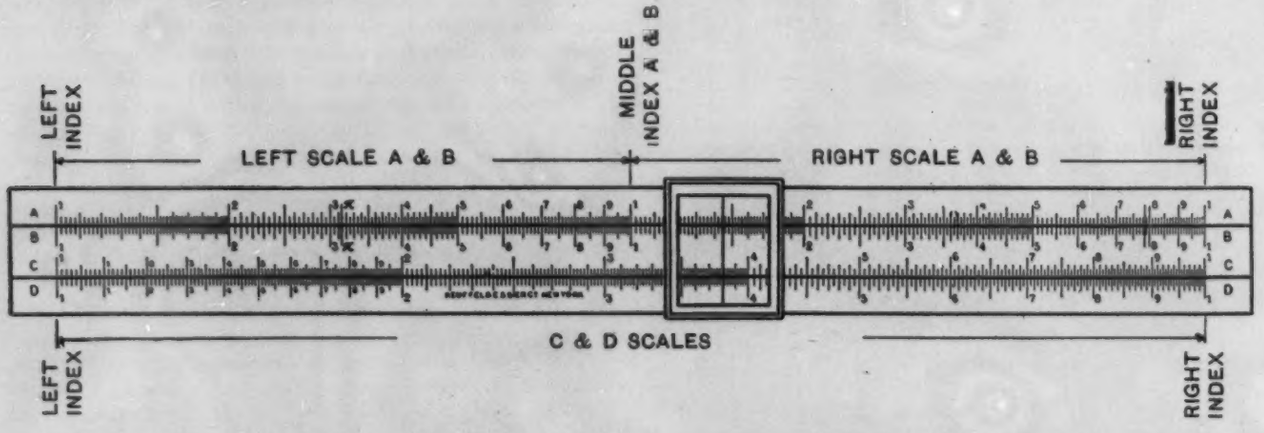
L. W. Holbrook: If you have a big compound engine for fire service and want to start up in a second, high and low pressure steam-jackets will make this possible, but there is no economy. This is a special advantage. Heat is on the steam-jacket all the time, and it takes but little fuel to keep the steam on all the time. At the present time it is an open question whether or not steam-jacketing pays when judged from the standpoint of fuel consumption. For emergency service as in the case of a fire pump the hot jackets make it possible to start up much more quickly than could be done with a cold engine.

THE SLIDE RULE.

BY J. G. DE REMER.

[The subject matter of the first lecture on the slide rule is contained in an article by Mr. De Remer in the issue of the Journal of Electricity for April 2, 1910.—Editor.]

The Mannheim slide rule has four scales; two on the rule, and two on the slide. These are designate as A, B, C and D scales as shown in the accompanying illustration.



The A and B scales are laid out to just half the length of the C and D scales. Hence the runner, if set opposite a certain number on the D scale is on the square of that number on the A scale. Thus over 2 on the D scale will be found 4 on the A scale; over 3 on D, 9 on A, etc.

For any given position of the slide the ratio of numbers opposite each other on the adjacent scales is constant. Thus set 2 on B over 3 on D and it will be seen that the ratio 2/3 exists throughout the range of the scales. This fact can be utilized in solving all problems in proportion by observing the following instruction:

C	Set first term	Under third term
D	Over second term	Find fourth term

Thus $2/3 = \frac{6}{?}$; by setting as above it will be found that 6 is over 9. This is a useful property of the slide rule, and by means of the following ratios the steam engineer can greatly facilitate his calculation:

226: 710 = Diameter of circle : Circumference of circle.
79: 90 = Diameter of circle : Side of equal square.
1: 231 = U. S. gallons : Cubic inches.
800: 107 = U. S. gallons : Cubic feet.
26: 66 = Inches : Centimeters.
31: 200 = Square inches : Square centimeters.
5: 82 = Cubic inches : Cubic centimeters.
75: 34 = Pounds : Kilogrammes.
57: 28 = Inches of mercury : Pounds per square inch.
720: 26 = Inches of water : Pounds per square inch.
60: 26 = Feet of water : Pounds per square inch.
15: 17 = Inches of mercury : Feet of water.
90: 2960 = Atmospheres : Inches of mercury.
34: 124 = Atmospheres : Pounds per square inch.
125: 124 = Initial pres. steam : Average pres. ⅞ cut off
55: 53 = " " " : " " ¾ " "
37: 34 = " " " : " " ⅝ " "
13: 11 = " " " : " " ½ " "
31: 23 = " " " : " " ⅜ " "
57: 34 = " " " : " " ¼ " "

All problems in multiplication can be reduced to proportions similar to the above. Thus $2 \times 3 = 6$ may be read $\frac{2 \times 3}{1} = 6$ or $\frac{2}{1} = \frac{6}{3}$. Hence set 1 on C over 2 on D and under 3 on C find 6 on D or vice versa set 2 on C over 1 on D and over 3 on D find 6 on C.

The rule for multiplication is:

C	Set 1	Under the other factor
D	On one factor	Find their product

[1]Lecture given before California No. 3, National Association of Stationary Engineers, Aug. 4, 1910.

In division the procedure is similar $6 \div 3 = 2$ or $\frac{6}{3} = \frac{2}{1}$. Hence set

C	Set 3	Under 1
D	Over 6	Find 2

The rule for division is:

C	Set Divisor	Under 1
D	On Dividend	Find the Quotient.

In performing a successive multiplication or division the runner is useful. Thus:

Example: $12 \times 4 \times 5 \times 3 = 720$ is worked thus:

C	Set 1	Runner to 4	1 to Runner	Runner to 5	1 to Runner	Under 3
D	On 12					Find 720—Answer.

In the same way several divisions can be easily performed, and also a combination of multiplications and divisions, as in the case of a train of wheels, as

$\frac{71 \times 21.4 \times 35 \times 17}{8.5 \times 42 \times 5.8 \times 20} = 21.8$, which is worked thus:

C	Set 85	Runner to 214	42 to R	R to 35	58 to R	R to 1	20 to R	Under 17
D	On 71							21.8—Answer.

A little practice will enable similar problems to be worked out with ease. No notice has so far been taken of the real position of the decimal points, the finding of which has been left to inspection, which in many problems is all that is necessary. We now give the rules in full with examples and explanations.

Multiplication.—If the product is obtained with the Slide projecting to the left, its characteristic is the sum of the characteristics of the two factors; but if the Slide projects to the right, the characteristic of the product is the sum of the characteristics of the two factors less 1.

Example: $45 \times 2.5 = 112.5$.

The sum of the characteristics of the two factors is 3, and the Slide projects to the left, therefore the integral portion of the product is composed of three figures.

Example: $3.3 \times 18 = 59.4$.

The sum of the characteristics of the two factors is 3, but to obtain the result, the Slide projects to the right. The product contains, therefore, $3 - 1$, or two figures only in the interger.

Division.—If the quotient is obtained with the Slide projecting to the left, its characteristic is the characteristic of the dividend, minus the characteristic of the devisor; but if the Slide projects to the right, this difference must be increased by 1.

Example: $33 \div 7.5 = 4.4$.

The characteristic of the dividend, less the characteristic of the divisor, is 1, and as the Slide projects to the left, the integral part of the quotient contains one figure.

Example: $65.1 \div 21 = 3.1$.

The characteristic of the dividend, less the characteristic of the division, is 0, but as the Slide projects to the right, the quotient contains $0 + 1$, or one digit in its integral portion.

The slide rule is of value to an engineer only in proportion to the amount he endeavors to use it. It becomes a habit, as it were; and once mastered the rule seems indispensable.

To master it requires only a little application to the elementary problems after which the more complex becomes clear.

The engineer is referred to the "Mannheim Manual on the Slide Rule" for further explanation of its use, it being from that text that most of the above data was obtained.

PROTECTIVE DEVICES FOR ELECTRICAL APPARATUS.[1]

BY A. G. F. HEATHER.

The question of the adequate protection of electrical apparatus is one that deserves careful consideration by those concerned in the running and maintenance of plant. In the early days, when power undertakings were limited in area, and supply was carried out almost entirely by continuous currents at low voltage, the problem presented few practical difficulties. Fuses, which at first met any case that was likely to arise, were gradually superseded more or less by automatic circuit breakers, which were soon brought to a state of great reliability, and rendered excellent service under severe conditions. The advent of alternating current transmission at high voltage over great distances, and the development of power undertakings have, however, considerably changed the nature of the problem. At the present time, one of the essential features of protective devices, especially in the case of a large supply company, is that they must be so adjusted as to protect promptly and certainly the particular section of the system to which they are applied, without interfering with the supply to any other portion of the system. Each consumer's substation must be protected, so that a fault on the installation or low tension net work will cut out the installation only, without tripping the distributor which supplies probably several other consumers, and similarly, a fault on a distributor must trip only that line at the control house from which it is fed, without interfering with the feeder which supplies the control house from the generating station. Then, again, it must be remembered that temporary overloads, earths, and surges are very common occurrences, and must be carried without any interruption to supply. Any temporary disturbance, such as induction caused by a lightning discharge, an earth, or the opening of a switch carrying load, may cause surges all over the system, which would be quite heavy enough to trip other switches. With proper protection against excessive voltage, such as static discharges, these surges would be cleared in a few seconds, and hence the necessity has arisen for introducing time elements in trip gear, so arranged that a switch will only trip after an overload has been on the circuit for some appreciable time.

[1]Abstracted from May 1, 1910, Transactions South African Institute of Electrical Engineers.

The time elements may be fixed, so that the switch will trip after a definite number of seconds have elapsed, irrespective of the severity of the overload, or they may be inversely proportional to the overload.

As the question of alternating current supply is of very much wider interest to us on the Witwatersrand at present, I do not propose in these few notes to refer at any length to the protection of continuous current systems. Continuous current circuit breakers find by far their largest field in traction work and are, therefore, of most interest to traction engineers. They are practically all built on one principle, this being rendered possible by the fact that they are all operated on low voltage systems, although, of course, there is great variation in details of design as there must necessarily be in all switch work.

Turning now to the protection of alternating current systems, we find that the problem with which we have to deal is different, mainly because of the fact that nearly all alternating distribution is carried out at voltages which prohibit, or at least render undesirable, the direct connection of tripping devices to the main supply. This, however, is not altogether a disadvantage, as it introduces the possibility of actuating all tripping gear with a current of about 5 amps. at a pressure of 100 volts, by the use of current and potential transformers, thereby considerably cheapening and simplifying the wiring of the switch-board.

Apart from the protection of electric plants from lightning, with which it is impossible to deal in so short a paper as this, the main points to be considered are the prevention of injury from overloads, failure of supply, and reverse currents.

Overload protection is generally necessary in the case of feeders and motors, and may be accomplished in the same way on alternating as on continuous current systems. The growth of supply undertakings, and the consequent necessity of localizing interruptions as far as possible, and of carrying temporary overloads without any interruption at all, have, however, made it imperative to develop a system of protection capable of close adjustment as regards comparative severity of overload and its duration. These ends may be attained either by the use of fuses or of relays.

Fuses on the whole do not present a satisfactory solution of the problem of protection against overload. The design of fuses has made enormous strides since the early days of power transmission, when a fuse was simply a bit of wire clamped at each end under a thumb screw. A fuse for a 500 volt circuit was then looked upon as rather an uncertain piece of apparatus. It could be relied upon to break the circuit, centainly, but it might also break a good many other things in doing so. Fuses are now designed to operate on circuits of 60,000 volts, and they afford satisfactory protection without causing any serious after-effects. Nevertheless, they are open to many objections which render them less reliable than other systems of protection which depend for their action on purely mechanical and magnetic principles. Small local flaws, variations in cross section and chemical composition, cooling facilities, aging of the wire, security of contacts, and the temperature of the fuse previous to the occurrence of an overload all influence the blowing point to a certain extent, and contribute towards making the fuse on the whole unreliable. An old fuse rated at 100 amps may blow sooner than a new one rated at 50 amps on the same circuit. Fuses can only be calibrated by destruction, and the blowing point of one fuse is in many cases no indication that another of the same type will blow under the same conditions.

Methods of protection depending on purely magnetic and mechanical principles possess advantages over fuses, inasmuch as both the overload and time elements can be adjusted with great accuracy, and can be periodically checked and altered as the requirements vary. The actual tripping of the switch is accomplished in the same way with alternating as with continuous currents, namely, by causing a plunger controlled by a solenoid to strike the trigger by which the switch is held in position. The overload and time limits depend upon the action of a relay, or in some cases upon the blowing of a fuse connected in parallel with the tripping coil. In the latter case, the tripping coil is not intended to carry the full load current of the current transformer which operates it, but being of higher resistance it is short circuited by the fuse. This type of tripping gear is very useful in cases where no auxiliary current is available, and close adjustment is not of great importance, but it is open to the objections already mentioned in respect of the fuses.

A far preferable arrangement where an auxiliary tripping circuit, either alternating or continuous current, is available, is to employ relays. The use of an auxiliary current has the great advantage that the force employed to operate the main switch is invariable, whatever the load on the relay may be. In three-phase work it is advisable to use two or three single-phase relays, rather than to combine the action in a three-phase relay.

Coming now to the question of protecting generators operating in parallel, it is usual to dispense entirely with overload relays, and to rely solely on reverse current protection, or in some cases to have no protection whatever, but merely an indicating device for each machine, which will warn the switchboard attendant in case a fault develops on any machine. A modern generator will carry a heavy overload for a time sufficient to enable the attendant to take steps to remove any fault on the system, or in case of necessity to run up and synchronize another machine. Overload protection on generators is rather a source of danger than otherwise, since, if a heavy overload comes on, or a fault develops, causing one machine to trip, the load will all be thrown on the other machines, and they will probably trip as well, causing a total shut down of the plant. The best system to adopt is generally accepted to be only reverse-current protection for generators, and overload protection for feeders, together with some discriminating device in the case of duplicate feeders and ring mains. These discriminating devices, some of which will be dealt with later, are so arranged as to cut out only the faulty section of the feeder or feeders, while an uninterrupted supply can be maintained on the sound sections. With only reverse current protection on the generators, the bus bars are left unprotected, but faults on bus bars are, or should be, comparatively so rare that this is not really a serious objection. Reverse-current protection will cut out a

generator for any fault in itself or its prime mover or exciter, but will leave it free to carry any ordinary overload that it may be called upon to take, provided its power factor does not fall too low.

Reverse-current relays are, in general, similar to overload relays, except that they depend for their action on the resultant or a shunt and series field. On inductive circuits it is usual to arrange the coils so that they act in direct opposition at the normal power factor. If the current becomes reversed in phase the action of the series coil is added to that of the shunt coil, and the relay at once operates. In practice, however, the relay is generally set to operate at low power factor, that is, before an actual reversal of the phase of the current takes place. A certain margin of reverse current is usually allowed in order to avoid tripping a machine if it should happen to be paralleled when slightly out of phase.

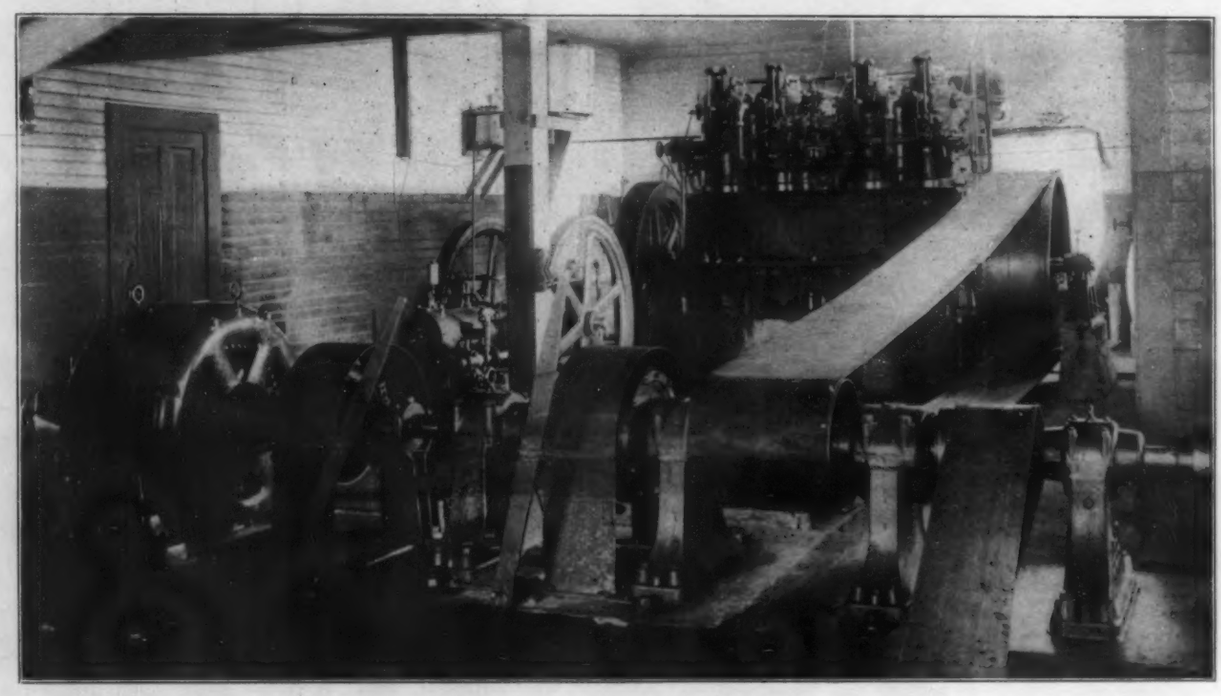
In addition to protecting motors against overload, it is necessary to arrange for the motor to be cut out in case of failure of supply, owing to the absence of any external resistance in the armature or rotor circuit when the motor is running at speed. This point is of very much greater importance when the power is supplied from an outside source than in the case of a private supply, as in the former case it is essential that the supply should be resumed as quickly as possible, without reference to the time required by any individual customer to go round and switch out all his motors by hand.

The system adopted for cutting out motors in case of failure of supply, is to connect a solenoid across the mains. The solenoid is energized as long as there is voltage on the system, and consequently holds its armature in position. Immediately the voltage fails, the armature is released. In some cases this shunt coil is applied to the main circuit breaker, and operates the same trigger as the overload coil. Occasionally, however, more especially in the case of small motors, the shunt coil is fixed on the motor starter and operates on the switch arm against the action of a spring. When all resistance is cut out the switch arm is in contact with the pole-pieces of the shunt coil, and forms the armature for them.

On high tension systems no voltage release can be accomplished in the ordinary manner by means of potential transformers and relays, the latter of course being set to operate instantaneously.

THREE IN ONE.

It is seldom that an electric power plant is equipped with three prime movers, a water-wheel, a gas engine and a steam engine, as shown in the accompanying view of the Winnemucca Light & Water Company's plant at Winnemucca, Nevada. The water-



Power Plant of Winnemucca Light and Water Co.

wheel is a 150 h.p. Pelton, the gas engine a 175 h.p. Doak all belted to the same driving shaft as is the 125 h. p. steam engine. Any one, two or three of these engines at will can be used to operate the two 50 kw. generators supplying light and power to Winnemucca.

The chief reliance for the greater part of the year is placed upon the water wheel which is supplied from a 500,000 gallon reservoir four miles from the plant through a pipe line made up of 12, 10 and 8-in. pipe, there being 7500 ft. of each. The head is nominally 1100 ft. varying with the change of season from wet to dry. The water as discharged from the wheel is collected in settling reservoirs of cement where it is piped throughout the town for general use.

The gas and steam engines are stand-by auxiliaries for use during periods of low water or at times of overload, a not infrequent occurrence. This novel combination was installed by Mr. W. L. Aiken, the superintendent of the plant.

JOBBERS' MEETING AT DEL MONTE.

A convention of the Pacific Coast Electrical Jobbers' Association was held at Del Monte, California, August 4, 5 and 6, 1910. Invitations had been extended to a number of manufacturers' agents, their presence contributing to the success of the meeting. Thursday was devoted principally to golf practice and other amusements. The business meeting was called to order at 9:30 a. m. Friday and lasted through the entire day with an evening session till 9:30 p. m. Saturday morning the meeting was called to order for final work and adjourned at 9:30 a. m. to meet again at Catalina Island for the fall meeting. Golf formed the principal pastime, the incentive being a handsome silver cup presented by Mr. Clark, son of Senator Clark of Montana, whose interest as a copper producer is closely allied with the electrical jobbers as copper consumers. The excellent singing of Frank Fowden was the primary cause of the presentation, which was handily won by W. L. Goodwin of the Pacific States Electric Company with a gross low score of 87. The score of 88 made by W. S. Berry of the Western Electric Company, made a close second.

The banquet was held on Saturday evening, the management of the Del Monte Hotel excelling themselves not only in the decoration but also in the viands. Tracy Bibbins of the General Electric Company acted in his usual graceful way as toastmaster and the feast of reason and the flow of soul that emanated from that festive board were gems of thought that the Journal regrets exceedingly cannot be given in full.

After R. S. Holabird had entertained his listeners in lighter vein, E. K. Patton gave an able address on "Co-operation Between the Jobber, Manufacturers' Agent and Manufacturer," speaking in the highest praise of the harmony and strength shown by the local representatives of these interests. His remarks formed the basis of much that followed and were received with hearty applause.

The toastmaster in behalf of the association then thanked Mr. Clark for his generous gift and suggested that he be made an ex-officio member. The motion was carried unanimously and three hearty cheers were givn for the donor. Mr. Clark addressed the meeting and in well chosen words expressed his pleasure at being a member, and advised everyone present to devote their spare moments to practicing golf, for it was his intention to present a cup for the National Convention of the Electrical Jobbers which is to to be held at Del Monte in April. Will Goodwin of the Pacific States Electric Company was then requested to give his excuses as to how he happened to win the trophy. If there is one thing that Mr. Goodwin is justly entitled to, it is the sobriquet of "Honest Bill." He told of his great disappointment in his first drive, which he had hoped and prayed would be a perfect one, when the ball landed in the thick underbrush some distance from the links. After finding the ball he was about to make a massé shot, when he noticed a few feet from the ball a large snake coiled ready for a spring. He admitted that he was superstitious and that in order to win the trophy he must first kill the snake. Decision and action was the work of a moment. With a dry blade of grass he smote the snake and its dead carcass lay there in evidence. While there was no need of corroboration. Mr. R. S. Holabird stated that he had seen the snake if anyone doubted the story. The next drive was a trophy winner as it proved at the conclusion of the game.

Members and Guests at Del Monte Meeting. Pacific Coast Electrical Jobbers' Association.

Colonel Carter, also of the Pacific States Electric Company, was next called upon to address the meeting from the standpoint of the jobber. He handled his subject not only with skill but with convincing arguments. When he had finished the applause of approval was equal to the reception to Mr. Patton's address.

A. Z. Thompson of the General Electric Company, when asked to entertain the company, in most poetic language weaved a story so weird that for the nonce all felt that the beauty had pierced the ivory dome of even the most obtuse. F. F. Skeel of the Crouse

Hinds Company of Boston, ably seconded Mr. Patton's argument from the manufacturer's side of the question. Charlie Carter of Los Angeles told how he happened to be entitled to have his name engraved on the jobbers' cup. As co-operation was the slogan of every speech he explained how how he had won through co-operation. A cigarette given to one of the handicappers the evening before, gave him an enormous handicap. The constant coaching of John Cole throughout the game cinched the co-operation.

Then the patriarch of the manufacturers' agents of the Pacific Coast, John R. Cole, in his frank and straight from the shoulder manner, carried his audience by storm and asked that the jobbers be jobbers only, that the manufacturers confine themselves to manufacturing and thus allow the manufacturers' agents to co-operate to the last ditch.

providing a cup for which the jobbers are to compete. This is to be known as the Patton cup.

After the banquet, dancing and music was the order of the hour. Mr. Thompson and Mr. Holabird favored the audience with instrumental and vocal music, as did several of the guests of the hotel, among whom was Miss Lillian Berry.

The members and guests present were: H. V. Carter, C. H. Carter, W. S. Berry and wife, Frank Fowden, J. Shaufelberger, H. V. Averill, S. R. Dederick, T. E. Bibbins, C. C. Hillis, N. W. Graham, R. D. Holabird, J. S. Eels, F. B. Gleason, W. L. Goodwin and wife, Albert H. Elliott, Henry Frosch, H. G. Aylsworth, John R. Cole, Garnet Young, H. B. Squires, H. E. Sanderson and wife, S. B. Gregory, E. K. Patton, F. F. Skeel, E. J. Dwyer, Duncan Reynolds, A. Z. Thompson, E. B. Strong and wife.

The Cup Winners and Others.

Mr. Albert Elliott, beloved secretary of the association, in a flow of oratory and good stories, closed one of the most successful meetings the jobbers have ever held. The loving cup went the round. Old Lang Syne was sung and the co-operative meeting of manufacturer, manufacturers' agent and jobber passed into history.

As the competition for the cup put up by the jobbers for their guests had proven a tie between Mr. Patton and Mr. Gregory, the banquet was interrupted long enough to allow the tie played off in an individual putting contest on the carpet. A dainty flower was placed at each corner of the room indicating the hole, and the two contestants gave an exhibition of their skill. The first two holes were won by Mr. Gregory, the third by Mr. Patton and from the position of Mr. Gregory's ball after the fourth shot, it was suspected that Mr. Patton preferred to leave the cup on the coast than to take it East with him, for in place of a put Mr. Patton gave more of an exhibition of a drive from the tee, and Mr. Gregory was declared the winner. Mr. Patton of Bryant Electric Co. then announced his intention of

SCORE CARD.

Name of Player.	Gross Score.	Handicap.	Net Score.
W. L. Goodwin	87	0	87*
W. Berry	88	0	88
R. D. Holabird	94	†1	95
H. E. Sanderson	96	†10	106
C. C. Hillis	100	2	98
H. V. Carter	102	1	101
D. L. Reynolds	103	0	103
C. H. Carter	104	27	77‡
T. E. Bibbins	107	3	104
F. B. Gleason	112	3	109
J. S. Ells	112	22	90
S. B. Gregory	114	27	87†
E. K. Pallon	114	27	87
A. H. Elliott	117	18	99
H. B. Squires	125	27	98
J. R. Cole	126	10	116
C. R. Dederick	127	27	100
N. W. Graham	129	27	102
Jno. Schaufelberger	172	27	145

* Winner of best gross score, Clark's trophy.
‡ Winner of best net score cup.
† Winner of Manufacturers' cup.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE
Technical Publishing Company

E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
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604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 150 NASSAU STREET, NEW YORK
C. N. MANFRED, Eastern Manager
LOS ANGELES OFFICE, 107 SECURITY BUILDING

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Lubrication

Notwithstanding the large sums annually spent for lubricating oils, friction continues to create a tremendous power waste. Some authorities estimate that more than half of our fuel is consumed by friction, a large proportion of this waste being due to imperfect lubrication. Friction is a form of mechanical resistance and as such not only opposes the motion of rubbing surfaces but also causes them to wear and become overheated, the last being a too-frequent fire hazard.

Experience has shown that friction may be minimized by proper choice of bearing metals and by the intervention of some unctuous substance. Contact of dissimilar metals, such as a steel journal and a babbitt bearing, gives the best results for most requirements. It is necessary to exercise constant care to keep these rubbing parts in good condition, it being an absolute necessity that they be smoothly milled to true surfaces in order to reduce friction to the lowest increment of the power in use.

Lubrication's prime problem, however, is the proper introduction of an oil or grease that will keep the moving materials apart by means of a continuous, coherent and durable film having small internal friction. The first lubricant was water, which, while possessing no oiliness, is still used in cylinders to keep metallic surfaces smooth. Various oils and greases of animal or vegetable origin were next employed, but were soon superseded by mineral oils or by mixtures of both, these compounded oils being valuable in heavy work which breaks down lighter oils. Later it was found that excellent heavy lubricators could be prepared from the crude petroleum of Texas and California if carefully refined so as not to decompose the original constituents. Recently it has been found that deflocculated graphite, originally prepared in the electric furnace by Acheson, is an efficient lubricating agent for many forms of mechanical work. A small proportion of graphite mixed either with oil or water, the latter being merely a distributing vehicle, quickly forms a veneer that smooths the bearing surfaces and reduces to a minimum the coefficient of friction, that ratio of the force necessary to slide a body along a horizontal plane to its weight.

No one of the above lubricants is universally applicable, each particular kind of machine and special service to which it may be applied constituting a different problem. The chemical engineer has devised a series of tests by which it is possible to select the oil best adapted for the required work. In making such tests it should be his constant endeavor to closely approximate service conditions of speed and load, kind of bearings and method of feeding. It is thus possible to guard against the likelihood of a compressor oil carbonizing at the high temperature inherent in compressing air, or of an oil used in a circulating system, such as a steam turbine installation, emulsifying or oxidizing so as to clog or corrode the bearing. The full measure of power plant economy may be attained only by vigilant attention to such precautions.

PERSONALS.

E. K. Patton of the Bryant Electric Company is at Portland.

S. K. Colby, head of the railway department of Pierson, Roeding & Co., is at Los Angeles.

G. W. Merrill, superintendent of the Sacramento Electric, Gas & Railway System, has tendered his resignation.

Sidney Sprout is at Winnemucca, Nev., on engineering business for the Winnemucca Light & Power Company.

R. D. Holabird of the Holabird-Reynolds Company, has returned to San Francisco after an extensive Eastern tour.

Duncan L. Reynolds, of the Holabird-Reynolds Company's Los Angeles branch, spent the past week at San Francisco.

Edward G. Dewald, who recently joined the sales force of the Pelton Water Wheel Company, has returned from Utah.

Charles Casassa has been promoted from chief clerk to assistant auditor of the Pacific Telephone & Telegraph Company.

C. E. Ingalls was recently appointed manager of the small motor department of the Los Angeles office of the General Electric Company.

E. J. Dwyer, manager of the Holabird Electric Company, of Seattle, has returned to Puget Sound after spending a few days at San Francisco.

W. Jamieson, first assistant engineer of the Merchants' Exchange Building plant in San Francisco, is again on duty after his summer vacation.

Leon M. Hall, consulting engineer for the Comstock mines, has returned to his San Francisco office after an automobile trip to Virginia City, Nev.

D. P. Fullerton, division superintendent of the lines of the Pacific Telephone & Telegraph Company, has been making an inspection tour in Southern California.

W. S. Cone, superintendent of construction on the Great Western Power Company's large dam at Big Bend, spent a day at the company's city office during the past week.

Thomas Mirk, of Hunt, Mirk & Co., who recently returned from Eureka, is about to visit the Westinghouse Machine Company's works at Pittsburg. His itinerary will also include New York, Chicago and Milwaukee.

F. C. Phelps, C. W. Burkett and G. B. Bush, respectively auditor, general superintendent of plant and general commercial superintendent for the Pacific Telephone & Telegraph Company are making a trip over the Northwestern Division.

George F. Averill, president of the Coos Bay Traction Company is at San Francisco to confer with some of the backers of the new railway enterprise which will connect Marshfield, Ore., with a number of the towns in the Coos Bay region.

Dwight B. Dean, manager of the Kuhlman Car Company, Cleveland, Ohio, (one of the Associated Brill Companies), is at Los Angeles on a tour of the Pacific Coast. He will later visit Pierson, Roeding & Co., who represent his company at San Francisco.

J. E. Jones has joined the John G. Sutton Company as a construction foreman. He will be employed on the $11,000 wiring contract that the company has secured for the elaborate decorative street lighting for the Native Sons' Admission Day Carnival in September.

G. R. Field, assistant general manager of the Great Western Power Company, returned last week from an inspection tour covering the new work under way. Rapid construction work is reported on the dam at the Big Bend plant, while the exploration work for the projected impounding dam at Big Meadows is progressing nicely.

ELECTRIC SHOW EXHIBITORS.

Following is a partial list of exhibitors at the Pacific Coast Electrical Exhibition to be held in San Francisco September 17—24, 1910:

Standard Underground & Cable Co., American Steel & Wire Co., John R. Cole Co., H. W. Johns-Manville Co., National India Rubber Co., Elec. Ry. & Mfrs. Sup. Co., Kellogg Sw. Bd. & Sup. Co., Dean Electric Co., Crocker-Wheeler Co., Engineering & Maintenance Co., National Dictograph, General Acoustic Co., Benjamin Elec. Co., Holophane Elec. Co., H. F. Frosch Co., Collins Wireless Tel. Co., Parrot & Co., Aylesworth Agencies, Babcock Electric Vehicle Co., Rauch & Lang, Columbus Vehicle Co., Electric Review & Western Electrician, Pacific Electric & Mfg. Co., Home Tel. Co., Weston Elec. Instrument Co., Levy Electric Co., Otis & Squires, Electric Cleaner Co., Electrical World, S. F. Compressed Air Cleaning Co., Holabird-Reynolds Co., Drendell Sw. Bd. & Sup. Co., Keller Mfg. Co., Telephone Elec. & Equip. Co., Elec. Mfg. Co., National Elec. Lamp Ass'n., Amer. Ever Ready Co., Walters Surgical Co., Studebaker Bros., Elec. Storage Battery Co., Direct Line Tel. Co., Burroughs Adding Mch. Co., Southern Pacific Ry., Grant Flaming Arc, Sprague Elec. Co., General Elec. Co., Ft. Wayne Elec. Co., Laugenour Sales Co., Appleton Elec. Co., National Elec. Co., Excello Arc Lamp Co., Federal Sign Co., Pierson-Roeding & Co., Daggett & Co., Paraffine Paint Co., Kohler & Chase, C. C. Moore & Co., Cal. State Ass'n. of Elec. Contractors, Baker & Hamilton, Hoover Suction Sweeper, Stave Elec. Co., Simplex Elec. Co., University of California, Santa Clara College, Gray Telautograph Co., Cyphers Incubator Co., American Elec. Fuse Co., S. F. Gas & Elec. Co., Pacific States Elec. Co., Amer. Ironing Mch. Co., City Electric Co.

TRADE NOTE.

William D. Ward is at Denver, where he has closed up a large hydro-electric contract for the Pelton Water Wheel Company in connection with a development in Colorado.

R. F. Chevalier has removed his office and laboratory from Alameda to 729-731 Merchants' Exchange Building, San Francisco, Cal., where he is equipped to better the fuel economy of steam power plants.

The General Electric Company has sold to the San Joaquin Light & Power Company a 2000 kw. Curtis Steam turbine which is to be installed at Bakersfield where the Power Transit Company's plant was recently acquired. The new equipment comprises one A. T. B. 4, 2000 kw., 1800 r.p.m, 2300 v., horizontal condensing turbine generator set, arranged for 185 pounds steam pressure (with 2 pounds absolute back pressure) and one C. C. 8, 35 kw., 3600 r.p.m., 125 v., slant, 125 v., condensing Curtis turbine exciter set.

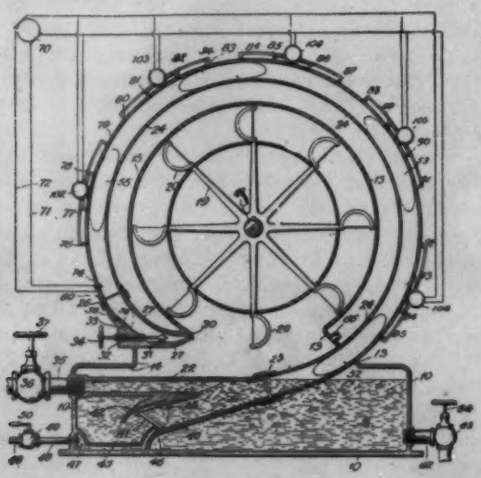
NEW CATALOGUES.

"The Cost of Light," by S. E. Doane, is ably treated in Bulletin 9A from the Engineering Department of the National Electric Lamp Association. The subject is first considered under the three heads of the cost of electrical service, the cost of electrical energy and the cost of lamp renewals, their weighted effect determining a logical central station rate.

The Electric Storage Battery Company has issued a booklet entitled "How to Get that Undeveloped Central Station Business." This book is for the purpose of interesting central stations in the popularization of the electric vehicle and explains how profitable this business is, and how easily it can be procured. Opinions of some central station experts are also given and diagrams showing methods of charging electric vehicles, both from d.c. and a.c. circuits. The booklet also contains announcements from eighteen electric vehicle manufacturers.

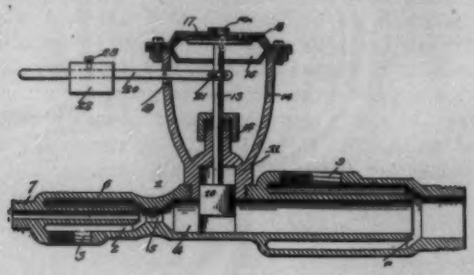
PATENTS

965,985.. Combined Liquid and Gas Turbine. Carl E. Brockhausen, Chicago, Ill. In mechanism of the class described the combination of an impulse wheel, mechanism by means of which the working fluid causes said wheel to rotate, means for admitting an explosive gas to said working fluid



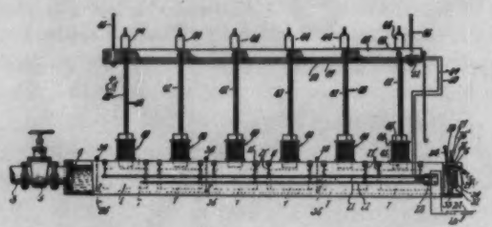
before it operates upon the wheel, means for exploding a bubble of gas upon the working fluid about to operate upon the wheel and mechanism for then successively exploding other bubbles of gas at different distances from the point where the working fluid operates upon the wheel.

966,373. Automatic Feed Regulating and Mixing Device for Crude-Oil Burners. Joseph B. Willings, Maricopa. Cal. A fuel feeding device for crude oil burners comprising a conducting tube having in one end an oil chamber, a steam injecting tube in said oil chamber, a mixing chamber surrounding the outer end of the conducting tube, a valve casing provided with a hollow dome screwing in the conducting tube between the mixing chamber and oil and steam injecting chambers, a regulating valve arranged in said conducting



tube and movable into the valve casing to regulate the quantity of oil and steam passing through the tube, a weighted lever pivoted to the casing and having a slotted engagement with the valve stem to normally hold the valve in raised position, a disk upon the upper end of the valve stem, an elastic diaphragh arranged in the casing and engaging said disk, and a cover plate having a steam inlet opening over said diaphragm, the diaphragm being adapted to move the valve in a cut-off position when the pressure of steam thereupon overbalances the weighted lever.

966,025. Apparaus for Purification of Sewage and Other Waters.. Lewis G. Lautzenhiser and Charles P. Chandler, Los Angeles, Cal., assignors of one-half to De Witt A. Siemmer and Shirley C. Ward, and said Chandler, assignor of one-twentieth to W. K. Reese, Jr., Los Angeles, Cal. An apparaus for the deodorization of sewage, comprising a flume having a smooth, continuous, imperforate bottom, a plurality of sets of electrodes supported in said flume, said electrodes extending in planes parallel to the length of the flume, a cross board extending transversely of the other end of the flume and separated



from the bottom of the flume to form a discharge outlet between said board and adjustable vertically to control the level of the sewage in the flume and the normal discharge from the flume, a discharge gate hinged to said cross board and extending downwardly therefrom to the bottom of the flume to normally close the said discharge outlet, and manual operating for opening said discharge gate.

966,323. Water-Gage Attachment. Zachariah C. Ferris, Caldor, Cal. A water gage glass attachment comprising an oblong sheet provided at distances from its opposite ends, equal to the width of the sheet with rows of transverse indentations and having one of its flat surfaces coated with a light color, a pair of angular-shaped channeled strips flanking the opposite ends and portions of the opposite sides of said sheet and extending to points approximately in alinement with the adjacent rows of indentations, and a second pair of chan-

neled strips arranged on the opposite longitudinal sides of said sheet and having their inner ends bearing on the extremities of the first-named strips in alinement with the indentations and their outer ends bearing on the opposite or outer extremities of the first-named strips, the outer end portions of the second-named strips being bendable over opposite ends of the sheet after the portions of the laater in advance of the indentations together with the first-named strips have been removed.

966,070. Solar Heater. William J. Bailey, Monrovia, Cal. A solar heater comprising a series of tubes of extended length and of relatively small cross section in communication with each other, and sheets of copper connected with the

botom walls of the said tubes for conductive heat to the lower part of the tube in which the colder water is, said sheets being in heat absorbing relation to the sun's rays for imparting additional heat to the tubes.

INDUSTRIAL

NATIONAL ELECTRIC LIGHT ASSOCIATION PLANS FOR THE ELECTRIC SHOW.

The advance of the electrical industry during the past decade has truly been phenomenal. The development has been so rapid that for a long time only the technical man was able to keep himself well informed regarding the progress made. The recent development of the industry has been largely along lines that are particularly interesting to the general public.

Fortunately, it is human nature to be inquisitive about new things. It is, therefore, natural to assume that the public is desirous of becoming acquainted with recent inventions and particularly those which promise to add to the comfort or safety of man. Manufacturers of electrical apparatus and devices have very gladly seized the opportunity thus afforded to place their products before the public for inspection, and consequently enormous sums of money are annually spent for the purpose of exhibiting goods of every description at industrial expositions. These expositions have aided materially in educating the public, and as a result have become exceedingly popular in several of the larger cities of the East. The names "Chicago Electric Show" and "New York Electric Show" have become widely known.

Many manufacturers consider the preparation of exhibits for these expositions as a regular part of the year's work. During the past twelve months electric shows of no mean success have been held at Boston, Minneapolis and St. Louis. Each year, also, there is a commendable exhibition of electric apparatus held in connection with the convention of the National Electric Light Association. The object of this exhibit is to bring to the attention of the association members, who represent a very large portion of the leaders in the electrical industry today, the annual progress in the application of electricity.

The East, then, is the pioneer in the promotion of electrical expositions. That the West has recognized the importance of promoting the general application of electricity is evidenced by the elaborate plans which have been made for an electrical exposition to be held in San Francisco, beginning September 17th.

Many of the largest manufacturers of electrical apparatus are planning to have elaborate displays at this exposition.

Fig. 1. National Electric Lamp Association Exhibit at New York Electric Show, 1909.

The handsome new Coliseum building is admirably adapted for shows of this sort, and will admit of a most attractive scheme of decorating.

Judging from electrical shows held in the East, one of the most attractive exhibits at the coming exposition will be that of the National Electric Lamp Association, the largest exclusive manufacturers of incandescent lamps in the world. The member companies of this association, through their engineering department in Cleveland, Ohio, have adopted a liberal policy governing their exhibits at electric shows.

Illustrations of what the National Electric Lamp Association has been doing in the past in the way of assisting these educative campaigns is shown in the accompanying pictures. Fig. 1 shows their elaborate booth at the New York Electric Show held at Madison Square Garden in October, 1909. This is one of the largest of the electrical expositions,

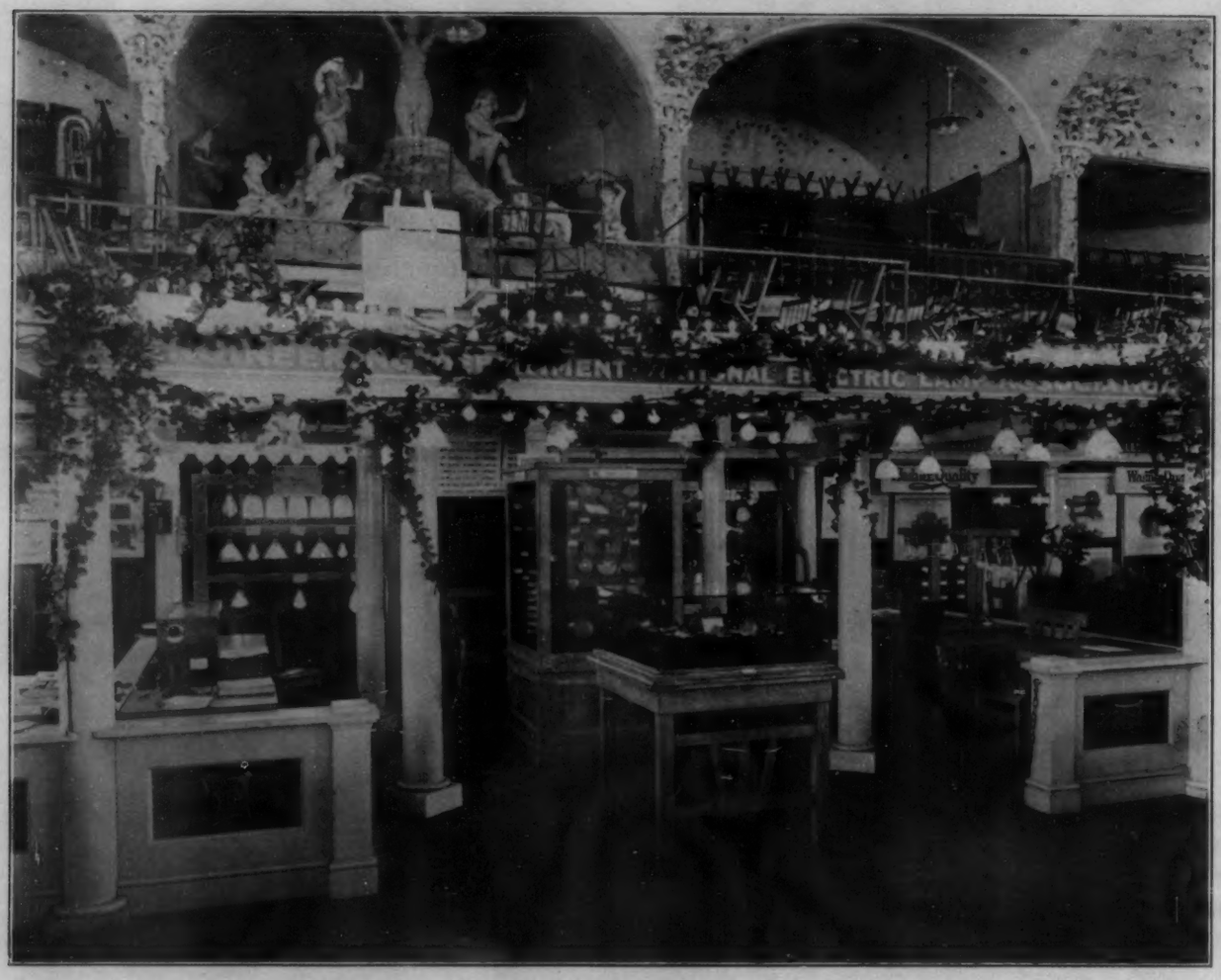


Fig. 2. National Electric Lamp Association at Atlantic City, 1909.

and attracts thousands of people annually. Fig. 2 shows the exhibit of this association at the thirty-second annual convention of the National Electric Light Association held at Atlantic City in June, 1909. The most recent exhibit of the company is shown in Fig. 3. This was the booth at the St. Louis Electric Show held in the Coliseum in June, 1910.

In view of the fact that the San Francisco show is to be the first large electrical show to be held on the Pacific Coast, the manufacturers are sparing no efforts to make it a success, and from present indications the show promises to equal anything of its kind ever held in the East or West.

NEW INTERPOLE RAILWAY MOTOR.

In further extending its line of railway motors Allis-Chalmers Company has recently placed on the market its Type 501. This is an interpole motor which has been developed to meet severe conditions of operation, especially on lines which use a potential of 600 volts or over. It also has desirable features for use where a lower voltage is employed.

As is seen by the accompanying photograph, the motor is unusually sturdy and strong with ample provision for wearing surface in the bearings. The arrangement of the interpoles can also be plainly seen. Special arrangements are made for ventilating the motor and therefore very cool running is secured.

The field frame is constructed of high quality cast steel and is split horizontally through armature and axle bearings so that it may be opened downward. The commutator and brushes can be readily inspected by means of an opening of large size which can be covered when the motor is not being inspected.

The main pole pieces are of soft steel punchings, securely clamped between malleable iron end plates, to which they are riveted. The interpole or commutating pole pieces are of solid steel. The field coils are of the mummified type thoroughly insulated and with the insulation impregnated with a moisture and water-proof compound. The coils are firm and have excellent heat conducting properties which assist in the cool running of the motor.

The bearings are bronze with a thin lining of babbitt and are carefully fitted to the bearing housings. Ample lubrication is provided for the bearings, and at the same time there is no chance for the oil to work into the commutator or windings. The armature journals are made amply large and the axle bearing bushings correspond. The standard axle of the American Street and Interurban Railway Association can be used.

The gears are made of high grade cast steel and are furnished either in the solid or split type. The pinions are made from high grade hammered steel and are bored taper to fit the taper on the armature shaft. The gear case can be supplied either of sheet steel or malleable iron. The former is preferred, as it combines lightness with strength, and Allis-Chalmers Company has worked out a special construction which does away with difficulties formerly experienced.

The armature core is built up of soft steel laminations carefully annealed and varnished after punching. They are securely clamped between end heads which also have rims to support the coil ends a uniform distance from the shaft.

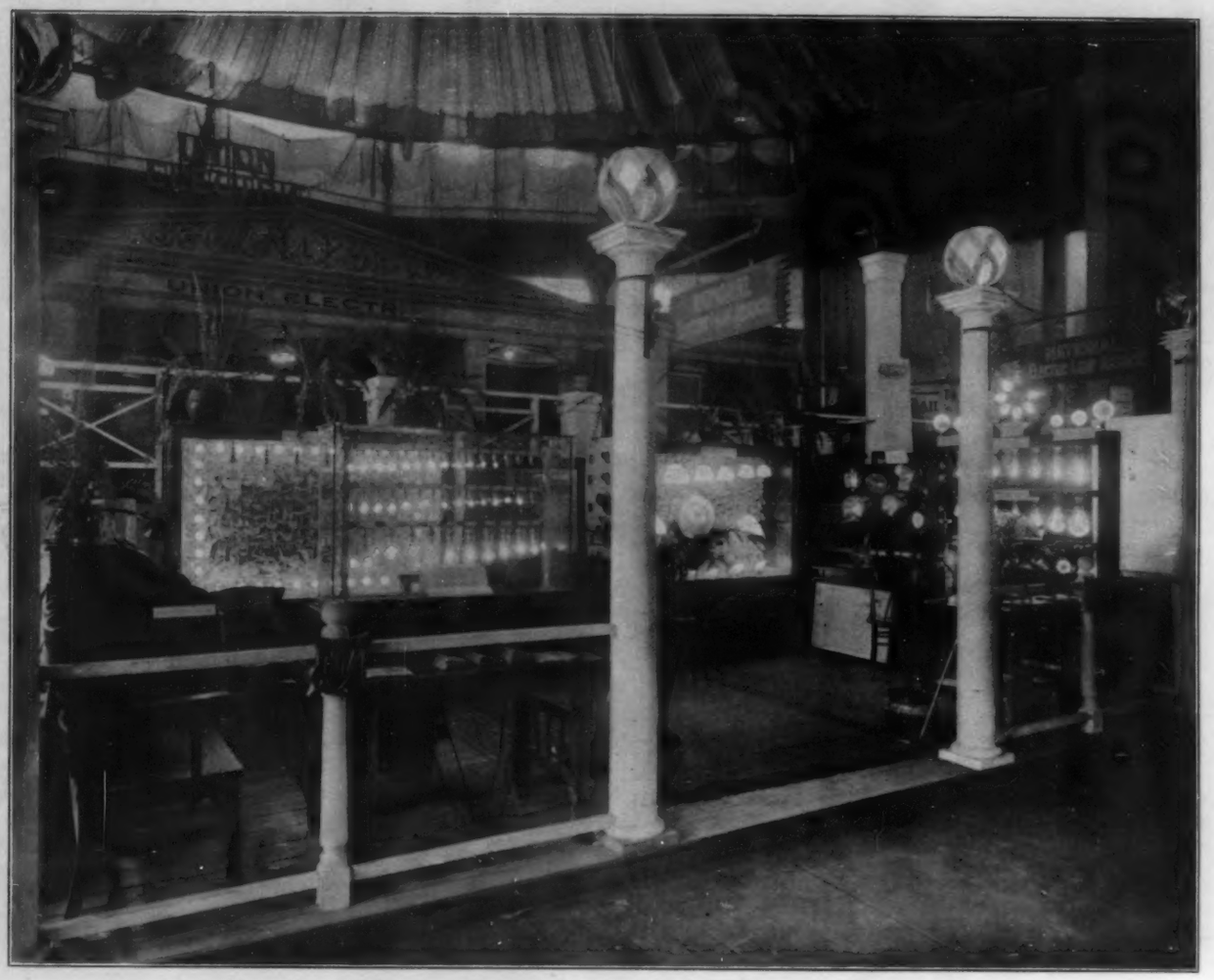
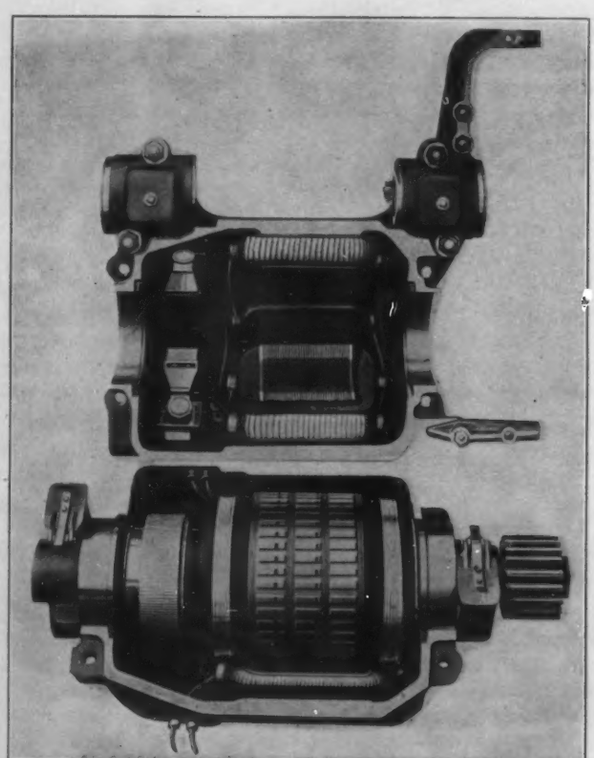


Fig. 3. National Electric Lamp Association at St. Louis, 1910.



New Interpole Railway Motor.

The laminations are built up on a cast spider and ventilation ducts are arranged. The spider also carries the commutator, so that shaft renewals can be made without disturbing the windings. The coils are wire wound and insulated in the usual way, but after being pressed in steam heated moulds are cooled under pressure, which gives each the same dimensions. This makes the coils absolutely interchangeable, which greatly reduces the labor whenever it becomes necessary to rewind the armatures.

Hard drawn copper commutator bars are mounted on a cast steel sleeve. Mica insulation is used between the bars and a one-piece mica cone ring is employed. The commutator is carefully constructed with ample dimensions and with creepage surfaces extra long.

Two cast brass brush holders are mounted in the top half field frame. They are each arranged for two carbon brushes held down by spring pressed arms. The holder body is adjustable to care for commutator wear and the brushes are kept in correct position. The brush end of the copper shunt or "pigtail" is so arranged that an exchange of brushes is easily effected.

The 501 motor is rated at 50 h.p. on 600 volts or 42 h.p. on 500 volts. These loads can be carried for one hour with a temperature rise not exceeding 75 degrees C. above the surrounding air. It has a continuous capacity of 36 amperes at 400 volts. The motors are designed for either double or four motor equipment and standard gear ratios are employed.

Allis-Chalmers Company is now building, in addition to the Type 501 interpole motor described, the non-interpole Type 301 rated at 40 h.p., Type 302 rated at 55 h.p. and Type 303 rated at 75 h.p.

NEWS NOTES

FINANCIAL.

JACKSONVILLE, CAL.—A municipal election has been called for the purpose of voting an issue of $30,000 bonds to provide for a gravity water system.

MOUNTAIN HOME, IDAHO.—The voters of Mountain Home will hold an election August 17 to decide on voting bonds for the construction of a system entirely in keeping with the requirements of the underwriters affording the very lowest rate of insurance.

INCORPORATIONS.

PETALUMA, CAL.—The Healdsburg Telephone Company has been incorporated by Eli Bush with a capital stock of $50,000.

NORTH BEND, WASH.—The North Bend Heat, Light, Water & Power Company has been incorporated for $20,000 by Fred E. Sander.

PORTLAND, ORE.—The Pacific Power & Light Company of Augusta, Me., has been incorporated to do business in the state of Oregon, with a capital stock of $7,500,000.

SANTA ANA, CAL.—The Freehold Water Company has been incorporated by W. P. and I. E. O'Meara, E. H. and T. M. Kennard and J. D. Pope with a capital stock of $100,000.

LOS ANGELES, CAL.—The Long Beach Consolidated Gas Company has been incorporated by A. E. Murphy, B. T. Story, H. F. Keenan, H. J. Bauer and L. J. Lee, with a capital stock of $1,500,000.

SAN BERNARDINO, CAL.—The Mill Creek Reservoir Company has been incorporated by W. H. Van Leuren of Redlands, Cal., N. P. Hinkley and J. M. Cole of Bryn Mawr, and J. H. Strait of Redlands, Cal.

SAN FRANCISCO, CAL.—The Merchants' Light, Heat & Power Company has been incorporated by M. D. Levenson, B. A. Goldsmith, W. Lilienthal, V. E. Mathews, A. J. Donovan, S. L. Yehl and J. Greenbaum with a capital stock of $1,500,000.

LEWISTON, IDAHO.—The Clearwater Telephone & Telegraph Company has been incorporated by Sampson Snyder, A. Anderson, F. Jones, J. Decourtesey and J. Fairley with a capital stock of $40,000. The proposed length of the company's line is 200 miles.

TRANSMISSION.

COLVILLE, WASH.—Paul La Plant was awarded the contract to construct an additional electric line from the power house at Meyers to this place.

VIRGINIA CITY, MONT.—It is reported that U. S. Senator Dixon and Spokane capitalists will erect a power plant at Three Forks, at a cost of about $200,000.

VANCOUVER, B. C.—The Western Canada Power Company will shortly award a contract for the 40 miles of ⅝ in. steel cable to be used on the transmission line from Stave river falls to this place.

REDDING, CAL.—On account of the illness of Attorney A. M. McCoy at Red Bluff, the water suit has been continued from August 22 to Sept. 12. This is the case of the power company vs. A. F. Smith et al.

COTTONWOOD, IDAHO.—The Grangeville Electric Light & Power Company has purchased the local light system and franchise. The plant will be improved and 18 miles of high voltage line constructed.

LOS ANGELES, CAL.—In order to protect the city's interests and those of bond buyers two friendly suits are to be instituted within a short time to test the city's legal right to issue and sell the $6,500,000 bonds recently voted by the people for harbor improvements and aqueduct power plants.

BALLS FERRY, CAL.—The ferryboat built by the Northern California Power Company has been completed at a cost of $2500. The boat was built expressly to transport heavy machinery across the river. The machinery is to be hauled from Anderson to the new power house at Coleman, four miles up Battle Creek from this place.

BERKELEY, CAL.—The City Council passed an ordinance granting to the Great Western Power Company, a franchise, to erect, construct, maintain and operate for a period of 35 years, piers, poles, metal masts and other superstructures for conducting electricity along public highways, public ways, etc., for furnishing heat and power.

CITY OF MEXICO, MEX.—Lic Francisco Alfaro has received a telegram from A. B. Adams & Co. of New York, to the effect that the capital of the Balsas Power & Irrigation Company, amounting to $200,000 has been raised and that the work of exploiting the concession which Lic. Alfaro secured from the government for the New York house will begin at once.

JACKSON, CAL.—A party of capitalists from the East representing the syndicate interested in the new power plant to be constructed on the Mokelumne river have been visiting this vicinity under the guide of W. H. Underwood, head of the General Electric Power Co. While in Jackson Mr. Underwood confirmed the report that engineers are in the field making final locations of the ditch line and power site, together with other important work preparatory to construction of the entire system.

TRANSPORTATION.

STOCKTON, CAL.—The Board of Supervisors has granted the Central California Traction Company a franchise through Fair Oaks to the Santa Fe.

SAN FRANCISCO, CAL.—The strike of the linemen on the Northern Electric is not having any effect on the company's time schedule. All trains are running on time without interference.

POMONA, CAL.—Vice-President W. G. Kerchoff of the Pacific Electric Railway, said when he was in Pomona last week that his company will at once begin further construction work in this city.

SPOKANE, WASH.—It is reported that James J. Hill will invade the territory now belonging to the Blackwell interests and the Milwaukee road by building an electric line from a point near Spokane to Priest Lake.

TACOMA, WASH.—A movement for active work toward the building of the proposed new interurban line, which will be over 30 miles in length, connecting Tacoma with Seattle, was made at the meeting of the Seattle-Tacoma Short Line Company. James B. Murphy, Lowman building, Seattle, is president.

STOCKTON, CAL.—Ground has been broken on the Stockton-Modesto electric interurban road near French Camp, south of Stockton, and a camp has been established along the side of the Western Pacific at the Priest place. M. L. Brackett expects to have all of the grading completed in 90 days. Practically all of the rights of way have been secured.

ROSEBURG, ORE.—The Coos Bay Traction Company has announced its intention of beginning within sixty days on construction of a standard gauge electric railway between this place and Coos Bay. Articles of incorporation have been filed for $1,000,000 with the Secretary of State. Geo. T. Averill is president of the company.

ALAMEDA, CAL.—Industrial Agent F. W. Hoover of the Southern Pacific states that the new Alameda County electric service of the S. P. will start operations this coming November. Hoover said that all of the pole lines, save for the High street, connecting loop, were in place. He explained that a delay in finishing the transmission power-house caused the opening of the service to be put off until late in the fall.

SAN FRANCISCO, CAL.—At the last meeting of the Supervisors a resolution was passed to print determining to grant a franchise for a street railroad from the intersection of Parnassus and Third avenues, along Parnassus avenue to Judah street to Ninth avenue to Pacheco street and authorizing the clerk to advertise for bids for the same, and fixing Monday, September 12, as the day for opening the bids and the awarding of franchise.

STOCKTON, CAL.—The last spike has been driven on the Central California Traction line between Stockton and Sacramento, and preparations for the opening of traffic about August 15 are being completed. The connecting link was made near Arno, and the finishing work is now being done. An express service between the two cities in one hour and 45 minutes is contemplated. There will also be an accommodation train, scheduled to make the run in two hours and ten minutes.

ILLUMINATION.

SPOKANE, WASH.—The Spokane Falls Gas Light Company is getting ready to make numerous extensions to its plant.

COEUR d'ALENE, IDAHO.—The Commercial Club is negotiating with the Sessex Construction Company of Atlantic City, N. J., with a view of having that company establish a gas plant here.

LONG BEACH, CAL.—The application of the Pacific Electric Company for a franchise on the harbor front has been withdrawn, the company's attorney saying there was no particular need for it at present.

FALLS CITY, ORE.—W. E. Newson, proprietor of the Falls City Electric Company, is making arrangements preparatory to the construction of a new power house which will be situated about two hundred yards below the plant now in operation.

SAN FRANCISCO, CAL.—The order heretofore made to the City and County of San Francisco to show cause why the Supervisors should not be restrained from enforcing the gas rates against the San Francisco Gas & Electric Company, came up on the law and motion calendar last week in the U. S. Circuit Court. By agreement of counsel the hearing was set for the first Tuesday in September.

THE DALLES, ORE.—The Columbia Power & Light Company which recently purchased the electrical plant and business of the Wasco Warehouse Milling Company will spend $60,000 in improving the electric system in Wasco county. Forty-five thousand will be expended in enlarging and improving the plant at White River falls, while $15,000 will be spent in this city by the concern in making improvements.

MARTINEZ, CAL.—The Richmond Light & Power Company has applied for a franchise to construct, erect, maintain and operate, over, along, across, and upon the county roads, highways, public ways, streets, lanes and public grounds, such poles, masts and superstructures as it may deem necessary to transmit electric current for the purpose of supplying electric current for power to persons. Sealed bids will be received by the Board of Supervisors for the franchise up to 10 a. m., September 6th.

ALAMEDA, CAL.—The city of Alameda is to purchase electric current for day service from either the Great Western Power Company or the Pacific Gas and Electric Company both of which companies submitted bids to the electricity commission. The Great Western concern agrees to furnish the municipality with a minimum amount of 175 kilowatts at a cost of 1c per kilowatt, current in excess of the minimum to cost 1½c. The bid of the Pacific Gas & Electric Company contracts for power at 1c per kilowatt and 3c per kilowatt for emergency energy.

SAN BERNARDINO, CAL.—Asking damages for over a million dollars the San Bernardino Valley Gas Company has filed suit against the Home Gas & Electric Company of Redland, W. R. Cheney, J. F. Dostal, C. S. Chestnut, Pacific Light & Power Company, San Bernardino Gas & Electric Company, a branch of the Pacific company, the First National Bank of Redlands, H. B. Duncan, Walter M. Campbell, Payton H. Moore and L. Cruickshank, W. G. Kerchoff, and A. C. Balch. The complaint charges that the defendants by filing a petition in bankruptcy sought to ruin the plaintiff company's business and credit. For general and actual damages sustained, the plaintiff asks judgment for $500,000; for punitive damages caused by the alleged malicious acts of the defendants the sum of $500,000 is asked and $3500 is demanded for costs of suit.

WATERWORKS.

MERIDIAN, ORE.—The village board of Meridian has let contracts for furnishing the iron tank and frame and also the pipe for the waterworks system.

SAN JOSE, CAL.—Bids have been ordered advertised for water pipe to be used in the construction of a water system on the Pacheco Pass road for road purposes.

SPOKANE, WASH.—Negotiations are now going on between the Washington Water Power Company and the Lewiston-Clarkston Investment Company of Lewiston, Idaho, for the construction of a power line between this place and Lewiston.

EL PASO, TEX.—The City Council has made a demand upon the International Water Company to install at once improvements to its system in the shape of new mains, pipes, fire hydrants, valves and valve boxes which the city engineer estimates will cost $25,000.

SAN FRANCISCO, CAL.—The construction of the fire protection mains leading from the Twin Peaks reservoirs to the initial center of the fan shape distribution system of pipes at Castro and Scott streets, has been awarded by the Board of Works to the Raisch Improvement Company for $44,205.40.

HILLYARD, WASH.—Plans for a new reservoir to supply the city of Hillyard with water are now on foot by members of the city council. According to the proposition now under consideration a reservoir having a capacity of 1,000,000 to 1,500,000 gallons will be built in Berg's addition, formerly set aside for a dump ground.

SEATTLE, WASH.—This city has begun condemnation proceedings for the acquisition of 35,000 acres of land in the Cedar River watershed, comprising all of the land not government land which the city does not now own in the watershed. When the condemnation proceedings shall have been finished the city will own 70,000 acres between the city and the summit of the Cascades, and will have full control of all the drainage naturally emptying into the Cedar River. The tract is to be acquired for the purpose of protecting the city's water supply from pollution.

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American Electrical Heater Co.... Detroit, U. S. A.

Aylsworth Agencies Co.....13 San Francisco, 165 Second.

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Benjamin Electric Mfg. Co..... New York, 27 Thames. Chicago, 120-128 S. Sangamon. San Francisco, 151 New Montgomery.

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Southern Pacific Co. .....16 San Francisco, Flood Bldg.

Sprague Electric Co. .....11 New York City, 527-531 W. 34th. San Francisco, Atlas Bldg. Seattle, Colman Bldg.

Standard Und. Cable Co..... 1 San Francisco, First National Bank Bldg. Los Angeles, Union Trust Bldg. Seattle Office, Lowman Bldg.

Star Expansion Bolt Co.....13 New York City, 147-149 Cedar. San Francisco, 1010 Howard.

Sterling Paint Company, ...12 San Francisco, 118 First.

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Western Wireless Equipment Co.. 4 San Francisco, Grant Bldg, 7th and Market.

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Westinghouse Machine Co..... 6 Pittsburg, Pa. San Francisco, 141 Second.

Weston Elect'l. Instrument Co....16 Waverly Park, N. J. New York, 114 Liberty. San Francisco, 682-684 Mission.

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